ne

SEPTEMBER 1951 2/-

GEOGRAPHICAL MAGAZINE

ALL CLASSES OF INSURANCE TRANSACTED

CAR & GENERAL INSURANCE CORPORATION, L^TD.

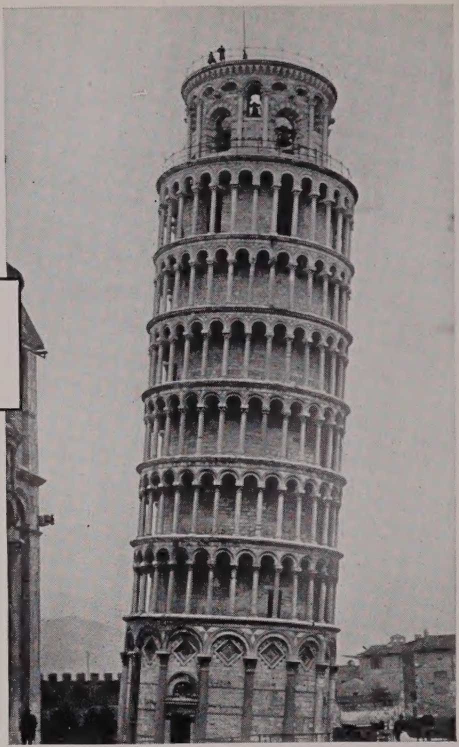
83 PALL MALL, LONDON, S.W.1

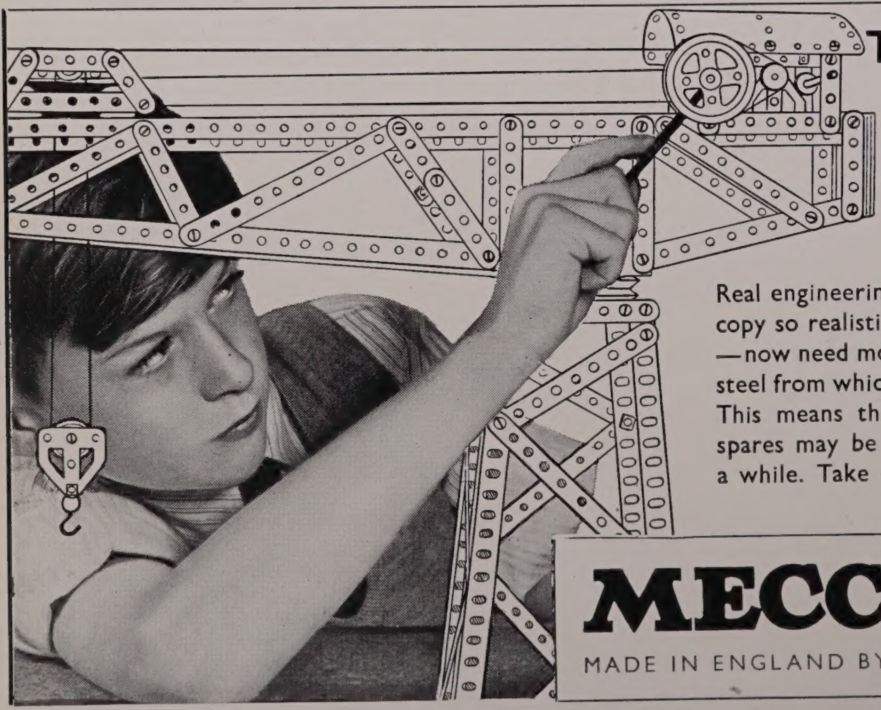
Around the
Tower of
London

or the
Tower of
Pisa . . .

**DUNLOP
is the
master
tyre**

1H/118





To all lucky Meccano owners . . .

Real engineering jobs—which you copy so realistically with Meccano—now need most of the brass and steel from which Meccano is made. This means that new outfits and spares may be difficult to get for a while. Take care of *your* outfit!

MECCANO

MADE IN ENGLAND BY MECCANO LTD.

Egyptian Museum, Turin

A battle between cats and rats, comically depicted on an Egyptian papyrus. If not strictly biological control, it shows an early attempt to keep one animal's numbers down by enlisting another

Animals and Man

V. Biological Control

by G. S. CANSDALE

Continuing his survey of the effect of human action on the geographical distribution of animals, Mr Cansdale, Superintendent of the London Zoo, describes the means by which, and the limits within which, scientists are able to redress the balance of Nature that man disturbs by transporting animals from one part of the world to another. He also shows how similar methods are used to control the spread of plants which, introduced into a new environment, have there become a pest

In a previous article I have shown how man, by introducing foreign elements into the natural fauna of a given region, upsets the balance of Nature, in which predators and prey have reached a state of comparative equilibrium. The balance is not usually a very stable one—indeed, animal populations can vary greatly in size. The possible range of their fluctuation may be illustrated by considering that if the innumerable species of herbivorous mammals and insects continued to reproduce themselves unchecked, they would in a few generations reach such levels of population density that their food supply would be destroyed. Yet it is relatively rare to see plants defoliated: various factors (termed "density dependent factors") kill off, or reduce the reproductive rate of, the species as its numbers rise and prevent them from reaching a level at which the plant is defoliated. We cannot say for any species of animal how the various factors combine to produce, and very roughly maintain, the *status quo*; still less can we say what long-term results will ensue from a change in existing conditions. All we can say, until quite a lot more is known, is that man interferes with them at his peril.

When, therefore, man transports animals and plants from one country to another—sometimes deliberately, sometimes by chance—such immigrants in their new environment may increase in a few years until they are far more numerous and destructive than in their native haunts. The principle of biological control is to seek the agents which prevent the immigrant species from being a pest in other parts of its geographical range and to re-adjust the balance by introducing them too. The object of biological control is to prevent the pest from doing significant damage; and this can be attained by reducing it to a low population level and keeping it there. Extermination is unnecessary; though if this were by chance achieved, no-one might grumble.

The ancient Egyptians have some claim to be the first people to practise biological control, for they used cats to keep down the mice which would otherwise have raided their corn stores. Mousing is no longer the domestic cat's whole *raison d'être*: even so, cats are probably the biggest single factor in keeping down the house mice in Great Britain, and many warehouse cats get their official milk ration for services rendered in this way. Darwin was fond of pointing out that the cat kills the mouse that eats the bumble bee that fertilizes the clover! Hence the clover seeds more heavily round farm-houses. The Romans were applying the same principle when they sent ferrets to Spain for rabbit control, though the result does not seem to have been recorded. The more recently attempted use of foreign carnivores to combat the rabbits in New Zealand and Australia merely emphasized the potential dangers of further upsetting Nature's balance in this way. The fox in Australia had absolutely no effect on the rabbit millions but turned to farm stock and was soon on the proscribed list itself. In New Zealand they tried members of the weasel family, but with equally tragic results, though here the chief sufferers were the unique native birds. These countries learnt some very hard lessons and their laws regarding the importation of animals are now the most strict in the world.

Jamaica was the scene of several early efforts at biological control. Brown and black rats had arrived there by ship in the very early days and they became a real menace to the sugar-cane plantations, even making it impossible to farm some parts of the island. As long ago as 1762 an ant (*Formica omnivora*) was brought in to prey on the young rats—one of the very few cases where insects have been used to control higher animals; it worked for a bit but then the effect became less noticeable and the ants themselves became a pest, as their Latin name suggests they well might. Next the Jamaicans tried a giant toad (*Bufo marinus*), with no effect at all; that was in 1844. After discussing it for a long time, the planters finally introduced the Indian mongoose in 1872. At first the rats suffered severely and the damage done by them was greatly reduced, but within ten years it was obvious that a fatal mistake had been made, for the mongoose was an omnivorous predator and attacked the ground-nesting birds and waterfowl as well as the snakes and lizards that were themselves good rat-catchers.

Nowadays, however, the greatest care is taken to ensure that the introduced species will feed only on species which man considers noxious, and will not turn its attention to other things. The controlling agents employed are mainly insects which are known to have remarkably fixed habits: so that even when their normal food (the pest) is rare they will not attack other beneficial species. Biological control is not a universal remedy. In fact it can be used only in a small minority of cases, but where it succeeds it often does so in a most spectacular and satisfactory way. It stands most chance of success where the pest is a specialized foreign invader. As indicated above, such insects or plants—chance introductions in plant stock, merchandise, etc.—often find an unoccupied niche awaiting them, with no competitors and no enemies; in other words, ideal conditions for them to become large-scale pests.

Some sporadic efforts at biological control had been made in Europe in the first half of the 19th century, and in 1883 a predatory mite sent to the United States attacked the imported Cabbage Worm with some success, but the first resounding victory was scored in a warmer climate about 1890. Very extensive citrus plantations had been developed in California, and insect pests were already becoming a problem. One of these, called the Cottony Cushion Scale, was such a serious pest that it threatened the very existence of the citrus industry, for insecticides had entirely failed to control it. (We have a number of scale insects in Great Britain, especially on orchard and forest trees; they are rather degenerate members of the same insect order as the more familiar Aphids or Green-fly.) This citrus scale was known to have come from Australia, and so a search was made for possible enemies in its homeland. A little Ladybird, later to be known as *Vedalia*, was selected for test and the first party reached California in 1888. Within eighteen months the citrus orchards were practically clear of Cottony Cushion Scale, and biological control was born. This Ladybird has since been introduced into many other citrus-growing parts of the world and has everywhere conquered this scale.

Ladybirds are ideal for insect control; they are generally rather specialized, attacking only one species or a narrow group of species, generally harmful to man's crops, and both adult beetles and larvae join in the attack. Other kinds of Ladybirds have been called in, mostly to deal with scale insects and Mealy Bugs, but insects in several different orders feature in other experiments. Several minute wasps, so small that an adult develops completely inside its prey, have also helped to make the control of citrus Mealy Bugs more or less complete, and similar wasps have been used in Hawaii to combat the Sugar-cane Leafhopper (something like our Froghopper), the Sugar-cane Borer (larva of a small beetle), and the Fern Weevil. Perhaps a weevil feeding on ferns does not sound very serious, but this one, an immigrant from New South Wales, set to work so vigorously that it threatened to interfere with forest cover in forest reserves.

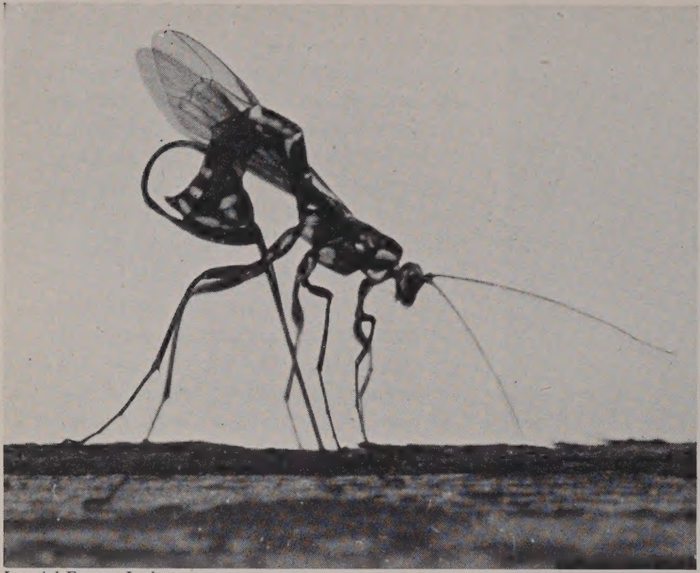
Biological control has been employed elsewhere in dealing with other forestry problems, almost without exception on trees growing out of their natural habitat. One of these experiments concerned a large wood-wasp, *Sirex*, accidentally introduced into New

In natural conditions there is always a fluctuating and complex balance between creatures that prey and those that are preyed upon. Insectivorous birds help to maintain this balance and in a sense may be said to exert 'biological control'. But their diet is normally too general to assist man in his efforts to reduce the population, or prevent the spread, of particular insects which he regards as pests and for this purpose more selective feeders are required. Insect enemies of the pests supply his need of allies. (Left) *A robin's beakful of larvae.* (Below, right) *A Ladybird eating a Green-fly, a familiar garden pest.* (Below, left) *The small black Ladybird* Vedalia *attacking the Cottony Cushion Scale on an orange tree in California. The white fluted substance is a protective covering excreted by the female Scale, which does her destructive work beneath it*

Ronald Thompson

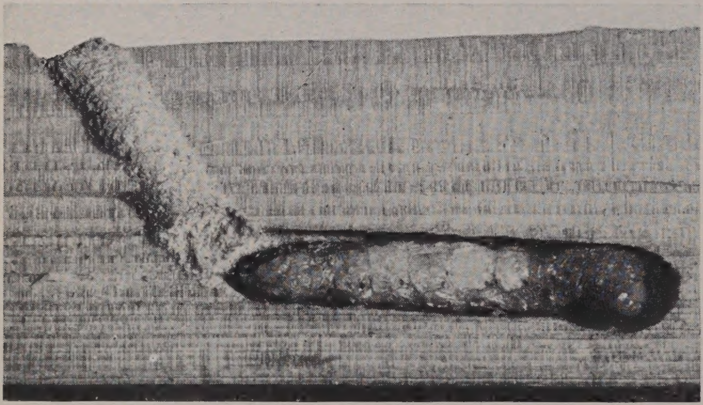
R. Kennedy, from the University of California

Fred. H. Wylie

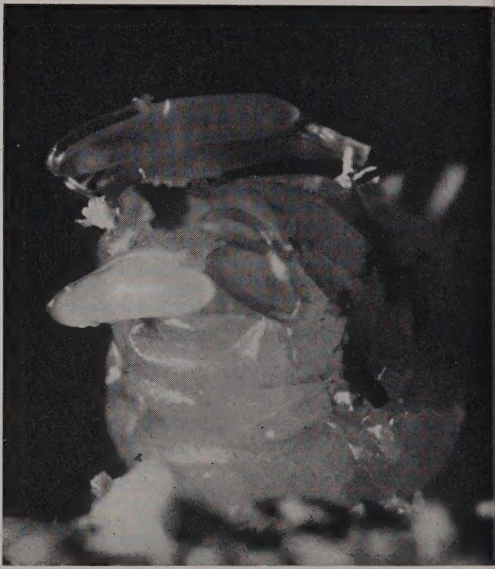


Imperial Forestry Institute

Parasites of injurious insects are often used to control them. The eggs of Rhyssa, *a wasp, are laid on the larvae (grubs) of* Sirex, *a wood-wasp which has severely damaged timber in New Zealand. On hatching, the Rhyssa grubs gradually eat up their 'hosts'.* (Left) *Rhyssa boring into timber with her ovipositor so as to lay her eggs on* (below, left) *a Sirex larva in its tunnel.* (Below, right) *Rhyssa eggs on Sirex larva: magnified eighteen times*



Imperial Forestry Institute



Imperial Forestry Institut

Zealand where it did a lot of damage to the imported Oregon pine. This wood-wasp, yellow-and-black and big enough to be mistaken for a hornet in flight, confines its attention to coniferous trees—pine, spruce, larch and silver fir mostly. The adult female deposits her eggs in the solid wood and the larvae spend up to three years eating and growing, in this time making tunnels as long as twelve inches and doing much damage to the timber. In this country it is of no great importance and its attacks should be taken as a sign that a plantation is in poor condition, but in New Zealand it became an economic pest.

Two parasites, both of them wasps, are native enemies of the wood-wasp and the larger of them (actually the largest kind of British ichneumon and as much as four inches over all) was selected for trial in New Zealand; its scientific name is *Rhyssa persuasoria.* This wasp has the uncanny ability to spot its prey, the growing wood-wasp grub, deep down in the timber, and to bore down with its ovipositor so that an egg can be placed on the grub. This hole may be over an inch deep and Dr R. N. Chrystal, who was responsible for the research on Rhyssa, noted that the drilling of such a hole took less than twenty minutes. He found that Rhyssa sometimes drilled down to a section of a tunnel no longer occupied but never wasted time at a place where no larvae had been. A tiny grub hatches from the egg and attaches itself to the host, which it gradually eats; it takes nearly a year to develop, though it is resting for much of this time, and about May it emerges from its cocoon to cut its way out of the tree and start life as an adult insect. For the control work a large dump of logs known to be full of wood-wasp grubs was made in an area where Rhyssa lived; these were soon thoroughly parasitized and in the autumn the logs were sawn up to obtain a good supply of the parasites. These were put in small gelatine capsules and sent to New Zealand where they soon developed and set to work.

Other examples from forestry of the use of insects to combat insects have shown moderate success but there have not generally been such overwhelming victories as those scored in the fields of agriculture and fruit-growing.

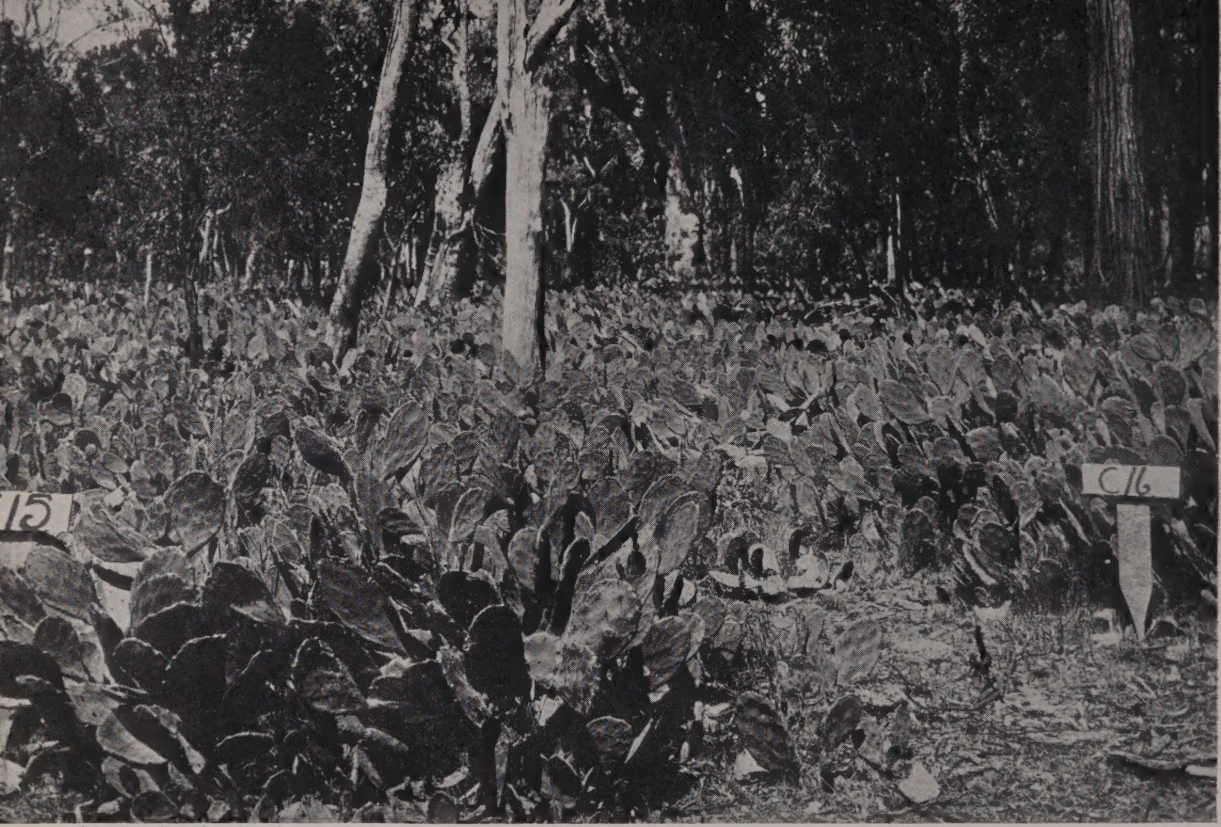
Man has also enlisted insects to help him control injurious plants. This problem is a very knotty one, for the greatest care must be taken to ensure that the insect cannot get out of hand by adapting itself to feed on cultivated plants. Elaborate techniques guard against this. To start with, only very specialized feeders are considered, and before any candidates are imported they are tried out with all plants of economic importance in their homeland, by being given the choice of feeding on these plants or of starving. If they pass this stiff test they then move to their proposed new hunting ground and are similarly tried out there on all the economic crops; this testing is done in insect-proof laboratories, so that there will be no accidental escapes. If an insect passes this test too, there is virtually no possibility of its becoming a pest.

The classic example of success in weed control by insects occurred in Australia in the middle twenties, when the Prickly Pear was at last conquered. Several species of cactus, all natives of the New World, had been introduced to Australia from time to time as hedge plants, but the real scourge developed from a single plant of *Opuntia inermis*, brought to New South Wales in 1839. For some time it behaved itself, but about 1870 this Prickly Pear got right out of hand. By the end of the century it covered 10,000,000 acres; by 1920, 60,000,000, and it was then spreading at the rate of some 10,000,000 acres per annum. As the ground was colonized, it became quite useless for grazing.

Meanwhile the search for the right insect had been going on, and several had been tried with a certain amount of success, but it was in 1925 that the real answer was found. This was the tunnelling caterpillar of a tiny moth native to Uruguay and Northern Argentina, and very expressively named *Cactoblastis cactorum*. The prescribed tests were carried out, and only one shipment of 2750 eggs was made. In 1926 and 1927 about 9,000,000 eggs had been produced in special breeding establishments and distributed. The caterpillars found no competitors at all and no enemies—for great care had been taken to introduce none of their parasites—and they got down to their work of eating out the

Insects can also control weeds. Gorse, introduced from Europe, is a nuisance in New Zealand. The gorse-seed weevil, brought in to combat it, is reared in insect-proof insectaries and studied in these outdoor 'cages' at Cawthron Institute, Nelson

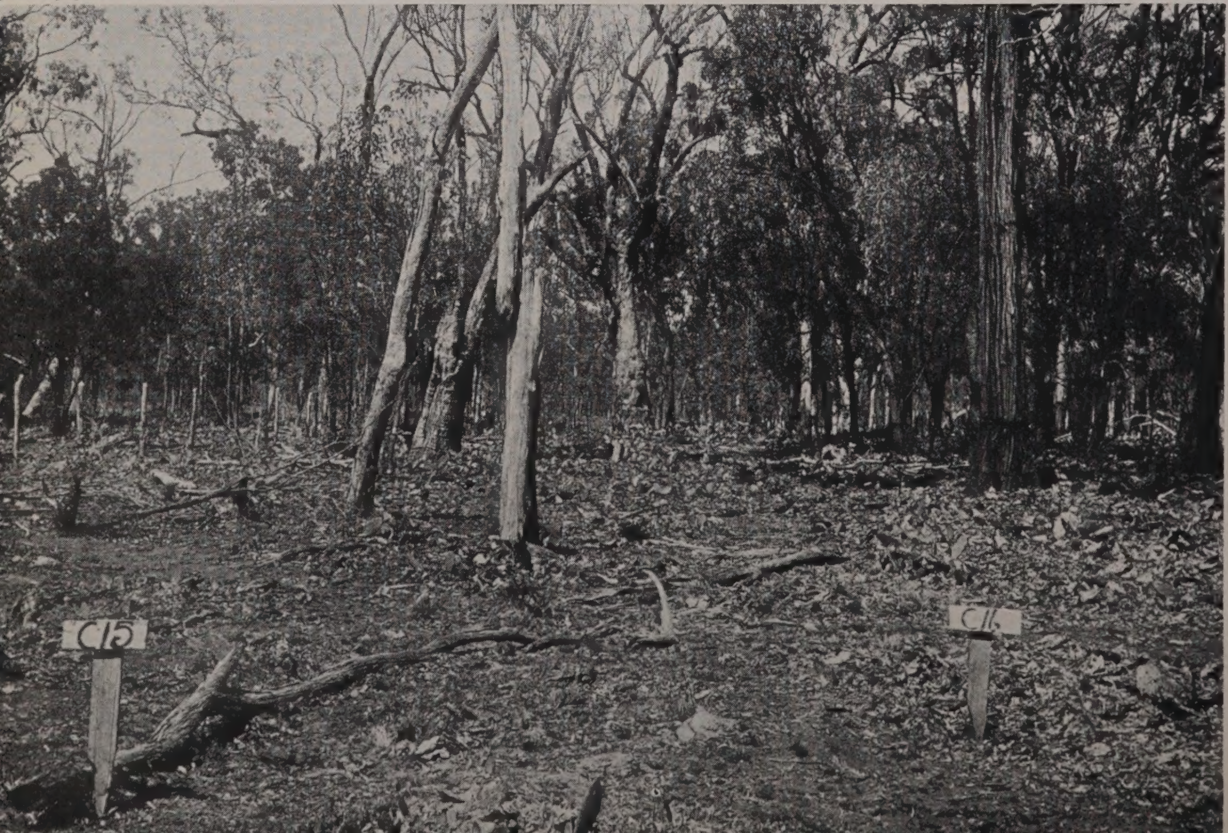
Cawthron Institute



y courtesy of the Australian News & Information Bureau

More than 60,000,000 acres of Australia were at one time rendered useless for grazing by the cactus known as Prickly Pear, an American plant. A South American moth was introduced with striking success. (Above) *An area of Prickly Pear in 1926;* (below) *the same area in 1929, cleared by the moth's larvae*

y courtesy of the Australian News & Information Bureau



A leaf-beetle that feeds only on St John's Wort is steadily devouring this plant which, of European origin, had overspread pasture land in California. The beetles, freed after testing, are here seen in action

J. K. Holloway, from U.S. Department of Agric

fleshy stems and letting in all kinds of fungi and bacteria. The result was indeed spectacular, as whole areas of cactus died completely and again became available for farming.

This victory is even commemorated in a poem published in the *Cactus and Succulent Journal of America*, but the caterpillar is such a specialized feeder that the implied fear is actually groundless.

So abandoning disguises
Cactoblastis chews away,
Till another problem rises
To confront another day:
When the pear pest in the past is
Who will blast the cactoblastis?

In California a battle is now being won over a familiar British weed—one of the St John's Worts—that first appeared there in 1900. It began taking over pasture land at the expense of the grazing plants and was itself poisonous to sheep and cattle. Australians had already been working on the same problem and had located possible allies, all of them beetles; after undergoing a further probation, one leaf-beetle (*Chrysolina gemellata*) was set to work in 1945. In less than three years twenty acres of dense growth was completely destroyed, and at the same time enough beetles had been reared to set up colonies over a wide area. The general effect is rather like a slow forest fire, with the flowering St John's Wort being killed by a slowly advancing wave of beetles. The whole job will take several years, but the end of St John's Wort as a pest in California is in sight.

The thorny shrub *Lantana* is a native of Mexico, but it has been introduced to many tropical and sub-tropical countries as an ornamental hedge. Where conditions have been just right for it, this shrub has got out of hand and has covered large areas. This has been especially true in India and in the Hawaiian Islands where it was taken about 1850. Early this century, as a result of an expedition to Mexico, a team of insects was enrolled to attack Lantana and eight members of the team established themselves. Each has a slightly different line of attack, but between them they make fairly certain that though some viable seeds still mature on most Lantana plants, the damage to leaves, fruits, flowers and tender branches is so continuous that it is no longer the pest it was.

Work on biological control goes on all the time and most Research Institutes have special sections dealing with it. Perhaps we are unlikely to see many more of the really spectacular victories such as that scored by Vedalia: the strictest control of imported plants aims at seeing that such situations do not develop. But as man understands better the interaction of the thousand-and-one different creatures composing the natural balance that he so rudely disturbs, so he becomes more skilful in getting animals big and small to help him achieve his objects.

The Northernmost Country of the World

by COUNT EIGIL KNUTH

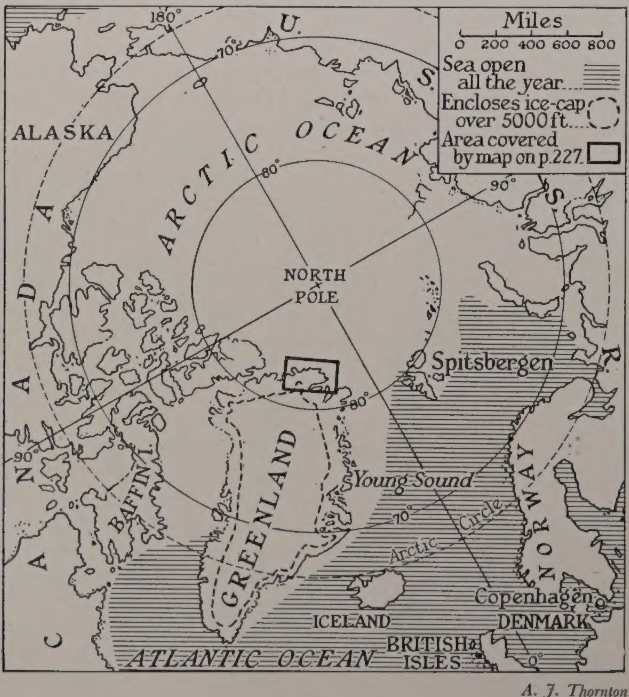
Readers of our July number will have seen what conditions are like, even in the Antarctic summer, at about latitude 72° South. The strangely different conditions at latitude 82° North, some 700 miles nearer *the Pole, are revealed herein by the leader of the Danish expedition whose members were the first white men to winter in Pearyland: an achievement made possible by using aircraft*

FARTHER north than any other country in the world Pearyland lies as an oasis in the ice-fields round the North Pole—a rocky country as large as Denmark. Snow-free and brown in the summer it is cut off from the rest of the world by the vast ice-cap of Greenland to the south and with the ever-white Arctic Ocean round its northern and western shores. It is a paradox of Nature, and a most improbable one it seemed to Peary one day in the spring of 1892. He had been travelling for two months towards the North Pole across the inland ice-cap and now found himself 6000 feet up, confident that this "Imperial Highway" would lead him comfortably to his goal. The inland ice, however, came to an end and opened up a vista of mountains, valleys and inlets as far as the eye could reach—a larger stretch of solid, ice-free land than is found anywhere else in Greenland; and that at the very threshold to the North Pole.

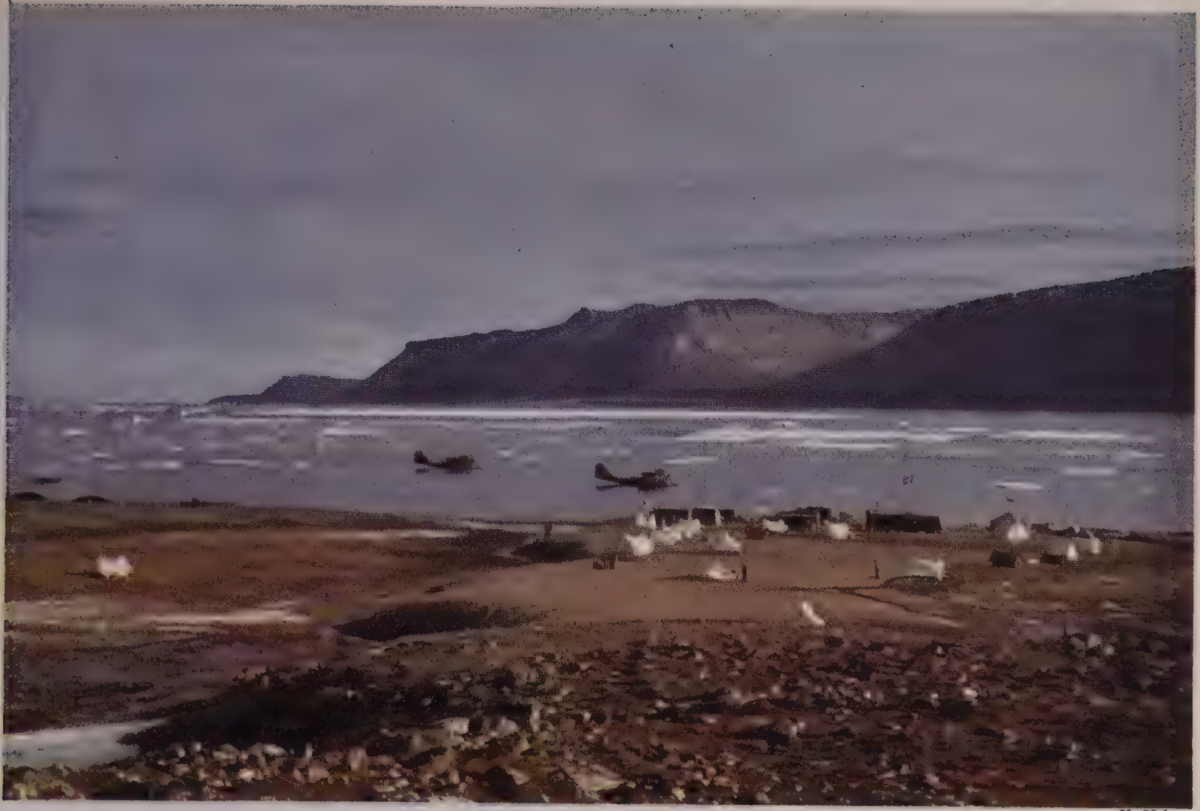
The story of the country north of the great glacier stirred the blood of explorers and adventurers, and during the next generation sledges made their tracks towards Pearyland. One of the sledge-parties never returned with the results of its explorations. It belonged to the "Danmark-Expedition" of 1907, and the tragedy that befell the three missing men is still something of a mystery. Our immediate predecessor in Pearyland was Lauge Koch, who with his "Bicentenary Jubilee Expedition" in 1921 finished up the era of the long sledge-journeys with a 200 days' tour round the whole Pearyland peninsula.

The outcome of all this was a map which gave a dependable, though roughly drawn picture of the contours of Pearyland, but only a casual knowledge of the climatic and geological conditions, the animal and plant life of the region. The collection of scientific material had been limited by the brief stays, the difficulty of getting one's bearings and the hunt for stores and dog-food for the long return journey. Only very little material had been brought home as the heavy sledges did not allow for any increase of weight. No-one had penetrated into the central part of the country, and although Lauge Koch in 1938 flew across it from Svalbard (Spitsbergen) and added inner valleys, lakes, mountains, and fjords to the map, Pearyland was still, scientifically speaking, a blank.

The only way of filling it in was to establish a settlement in Pearyland. This, however, could be done neither with sledges nor ships, for behind its fortifications of ice Pearyland lies far north of the

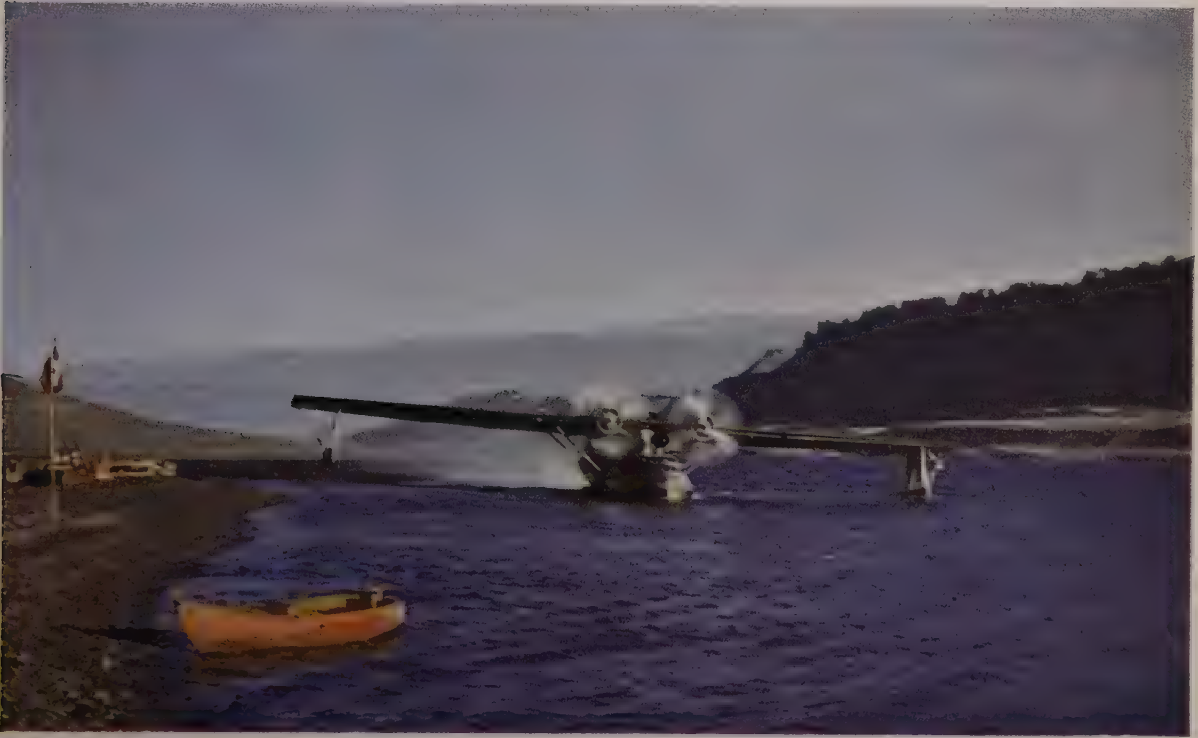


A. J. Thornton

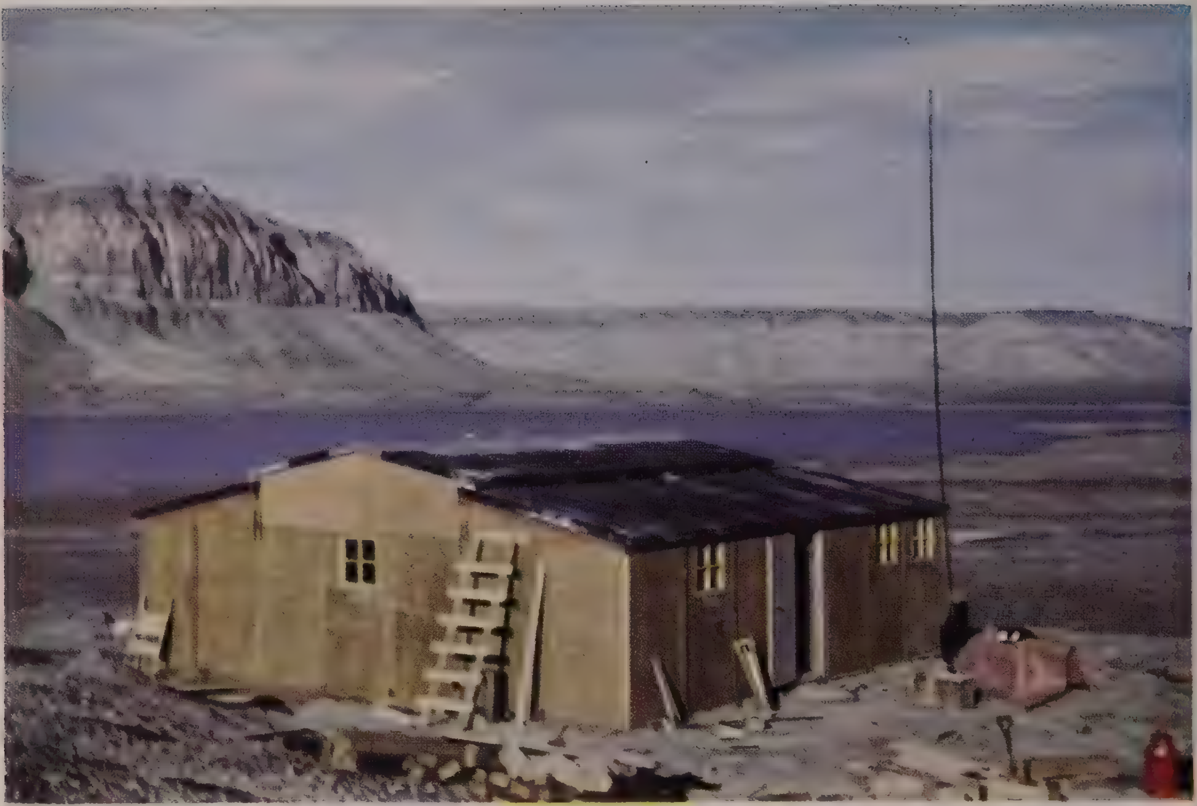


K. Holmen

(Above) *The South Base of the Danish Pearyland Expedition was in Young Sound on the east coast of Greenland at Latitude 74°.* (Below) *Jørgen Brønlunds Fjord in the extreme north of Greenland was found to be open long enough in the summer for material for the main camp to be brought there by the flying-boats from Young Sound*



B. Haagensen



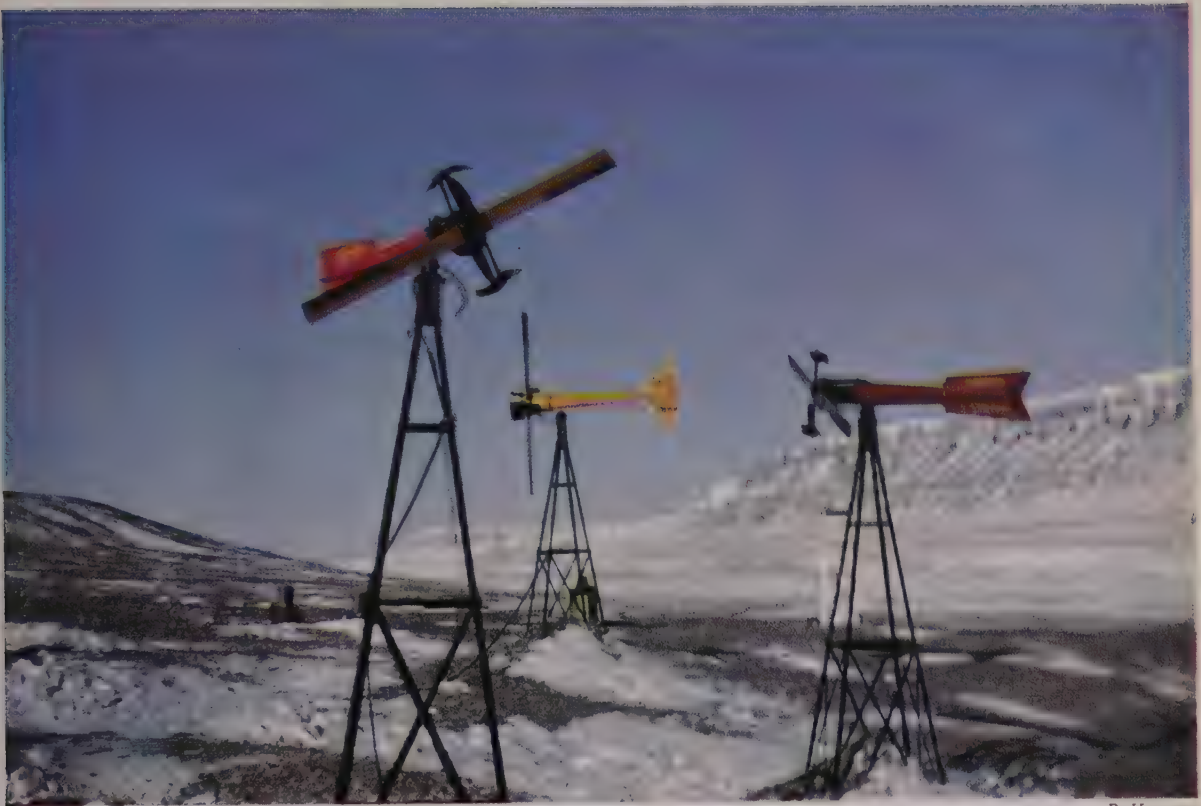
B. Fristrup

The northernmost house in the world nearing completion. Barely 540 miles from the North Pole, this prefabricated 'palace', consisting of a central commonroom surrounded by cabins for one or two men each, was transported from Denmark by an airlift that outrivalled the Arabian Nights

reach of ships. As Peary himself had prophesied, the means of solving the problem came with the aeroplane, but not until it rose like the Phoenix from the ashes of World War II, strengthened and improved by the development of radar and wireless. Now it was written in the sky that the investigation of Pearyland was imminent if only we would realize it and act accordingly. We did—we, because we were two: Ebbe Munck, Counsellor at the Danish Embassy in London, and I. Our plans aimed at a two-year hibernation, and we were hoping to establish our station at the small inlet, Jørgen Brønlunds Fjord, which as a branch of Independence Fjord cuts into the steep south coast of Pearyland. The fact that many large rivers drain into this small fjord led us to hope that the ice on it would break in the summer, thus making it a suitable landing-place for flying-boats.

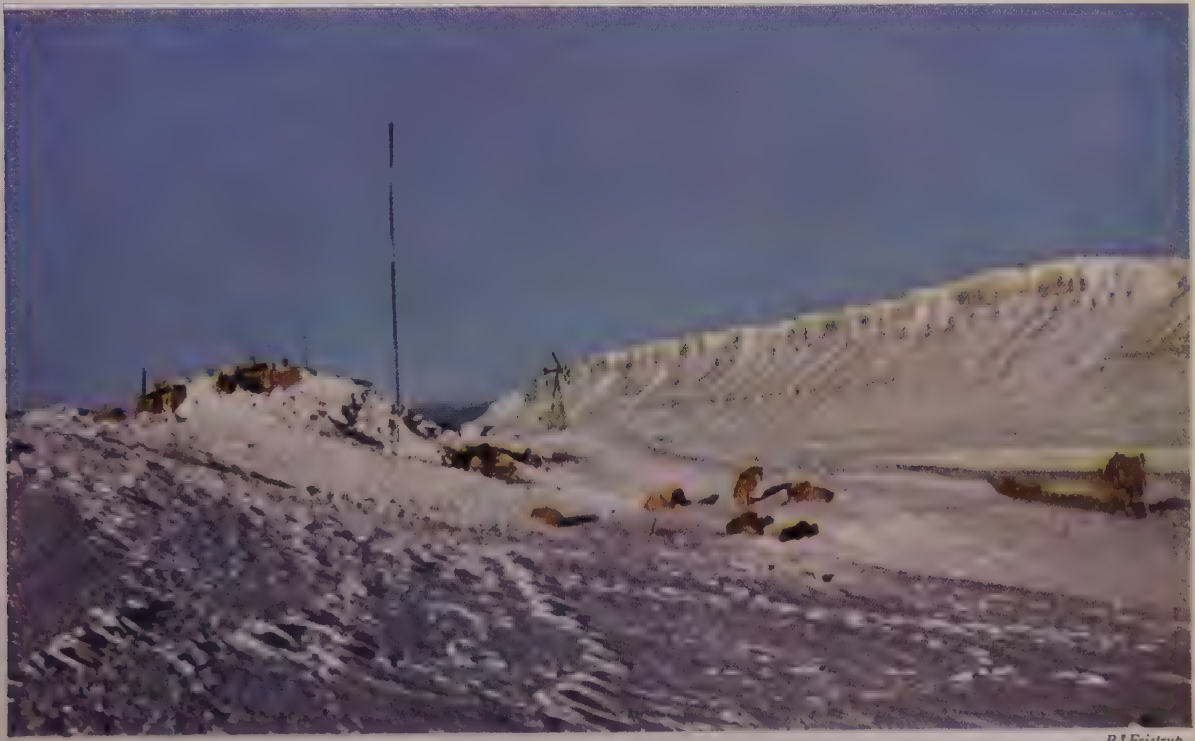
The Danish Government and "Dansk Expeditionsfond", founded shortly before by Ebbe Munck, gave us the financial backing. The Greenland Department placed ships at our disposal, and the Royal Danish Navy lent its new Catalina flying-boats under the direction of Commander Erik Overbye. The air transports necessitated the establishment of a starting base in North-East Greenland. For this purpose Young Sound, 74° North, was chosen, the distance from here to Brønlunds Fjord being about 560 miles. At the head of the sound, where it forms a wide bay under the Zackenberg Mountain, our South Base was set up. The attack started with a series of reconnaissance flights during the summer of 1947, and in spite of scepticism in many quarters we had the satisfaction that Brønlunds Fjord actually proved to be open for a brief period in the summer and to offer acceptable landing conditions.

The following summer three Catalinas were thrown into the attack and made twenty-two air trips between the South Base and the breach discovered in the defences of Pearyland. When, eventually, their noise died off, Pearyland had become populated and all its eight inhabitants had been provisionally installed in the newly established capital, the northernmost house in the world, at Jørgen Brønlunds Fjord, barely 540 miles from the



B. Haagensen

(Above) *There was almost always enough wind in Pearyland to turn the windmills which charged accumulators, thus saving petrol used in the motor-generators.* (Below) *In October the sun disappeared; four-and-a-half months later it shone again on the camp, here seen basking in its light after the long, dark hibernation*



B. Fristrup

K. Holmen

Stored in its vast fjords, Pearyland keeps wonders enough for seven worlds: each of its innumerable gigantic icebergs is unique, a continually moving piece of abstract architecture

B. Fristrup

Musk oxen herded together at the sight of a sledge in Pearyland. Almost five months of continuous daylight make it possible for animals and plants to live in the extreme north of Greenland

North Pole. The result of our air-raid was rather different from what experience of the war years had led us to expect from such actions: establishment of a community instead of obliteration, new life called forth. The Pearylanders settled in, accompanied by hammering and whistling. The windmills merrily joined forces with the wind which promised an unlimited supply of free current for the radio and the lights of the capital—and kept its promise. The chained dogs, filled with fresh energy at the feel of firm ground under their feet after their trip through space, fought great battles in the river.

Our achievement so far was of great significance. A bridgehead had been pushed into the unknown. The dogs enabled us to penetrate to any part of the country at any time. The house made it possible for us to carry out scientific survey work in the extreme Arctic field just outside our door. The botanist and the zoologist were able to concentrate on particularly interesting localities and investigate the influences which there govern animal and plant life under more severe conditions than anywhere else on the globe. Our individual cubbyholes were equipped as small laboratories complete with microscopes, tubes, test liquids and reference books, and here the material received a preparatory, classifying, descriptive and, to a certain extent, comparative treatment. Most important of all, each summer our material could be sent home to Copenhagen by aeroplane.

Our new country was certainly an oasis in the desert of Arctic ice but by climate and scenery it was in itself a desert. Pearyland was a highland plateau of yellow-brown lime- and sandstone intersected by broad valleys or narrow, winding canyons with steep, stratified walls. At lower levels such as the district round the station at Brønlunds Fjord it consisted of bare, clay banks sliding down the slope, or endless fields of wind-cut stones. These products of the action of the wind were never-ending sources of entertainment to us on our walks. In course of time most of the stones had been eaten up by the wind, but those of a more composite nature resisted in their hard parts and were hollowed in softer places. The result was often real works of art of abstract sculpture, and the surrealism of Pearyland displayed exuberant imagination especially in high places. There we went sightseeing when craving for art.

In spite of winds, frosts and drought our desert had a very rich animal life. It cul-

K. Ellitsgaard Rasmussen

(Above) *This young snowy owl lives, in Pearyland, nearer to the North Pole than London is to Inverness. The adults, which are completely white, would not allow members of the Expedition close enough to photograph them.* (Below) *The ptarmigan and hare on the other hand showed no fear of the human invaders of their Arctic home*

B. Fristrup

B. Fristrup

B. Fristrup

Nowhere more than in Pearyland, where vegetation is so scarce, do flowers delight man's eye and heart. In its stony desert they seem like miracles. (Above) *First to appear after the sun has returned and, moreover, the most beautiful of them all is the purple-flowered saxifrage.* (Below) *The yellow poppy*

minated in the summer, when ptarmigan, geese, eiderduck, gulls, terns, wading-birds and snow-buntings sought out their old breeding-places. Permanent inhabitants were lemmings, ermines, hares, foxes and musk-oxen, the latter the only large mammal left after the reindeer and the wolf had died out—the wolf only recently. Musk-oxen were everywhere to be seen and at their favourite haunts one might count as many as a hundred of them. While we were building our house, small herds would appear in the river bed where grass and Arctic willow grew. They would lapse into thought at our strange appearance and the way we moved, until an aeroplane roared overhead and we saw them gallop away with coats flying, leaving a cloud of dust behind.

While building operations were going on, a bear turned up and, it must be admitted, in this case the embarrassment was chiefly on our side. It happened on a cold, windy night when the first airborne party rested after a day's work in their kitchen tent in the middle of the camp in front of the building site.

B. Fristrup

K. Ellitsgaard Rasmussen

(Above) *In Independence Fjord high rock-walls streaked with black bands attested the volcanic activity of several hundred million years ago.* (Below) *More surprising was the discovery, in Brønlunds Fjord, of small crater-cones full of gypsum and sulphur, which may be signs of the beginning of a new period of volcanism*

J. Troelsen

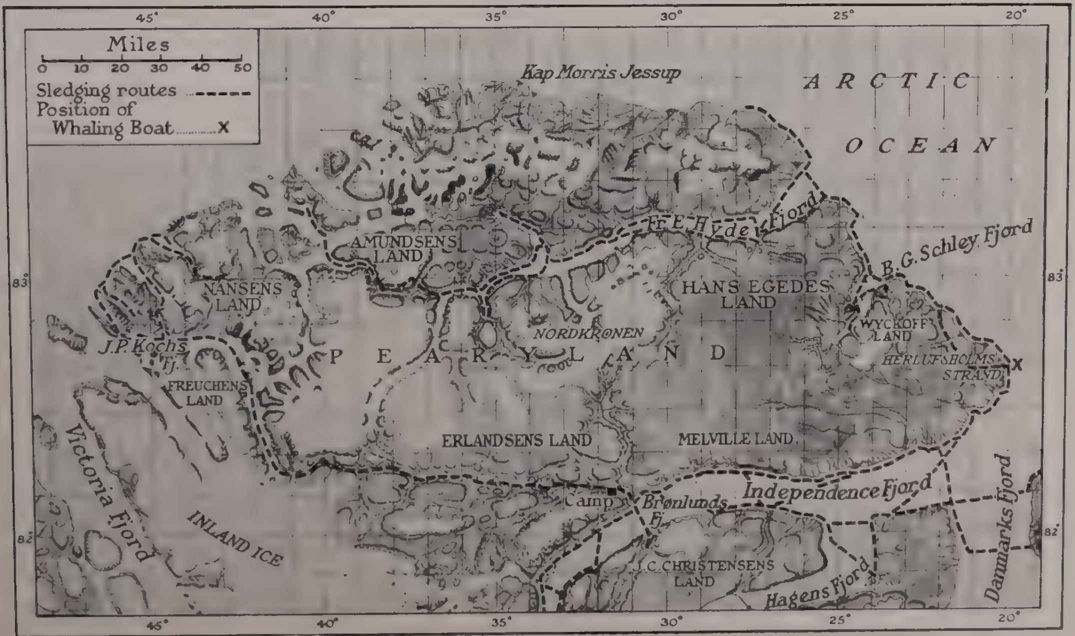
Coffee had been served, the primus put out and the door shut tightly against the cold outside. Suddenly there was a clatter of the saucepans left outside the door. The zoologist put his head out but quickly drew it back again—the origin of the noise was only too clear: "A bear".

It was of no use diving for any of the many guns in the tent as all ammunition was in the rucksacks in the various sleeping tents about the camp, and the bear was not likely to let anyone through. What a quandary! The camera man relit the primus and pumped it as high as it would go in order to encounter the enemy with a flame-thrower, should he poke his nose in. Absentmindedly the good zoologist armed himself with his butterfly-net, while the more practical carpenter drew out his dagger in order to rip open the back of the tent and make an escape that way.

The geologist, however, saved the situation. He conducted an organized chorus in a unison shout with the unpretentious wording: "Go to hell!" And off went the bear. Later he was rounded up and shot. In the name of science the zoologist worked his way into the carcase in order to find out what bears live on in Pearyland. The only thing found in an otherwise empty stomach was a partly digested bar of milk chocolate!

After the completion of the flights there was still another fortnight of summer in Pearyland. This was spent in making excursions in the neighbourhood where the geologist found about fifty small *solfataras*—volcano-like gravel cones topped with craters, the edges of which were covered with a brightly coloured crust of gypsum and sulphur. The emission of gases or vapours, during which the solfataras had been formed, had ceased. When the ice on the fjord was passable for sledges we were able to study traces of other volcanic activity on the south side of Independence Fjord. Here black bands and columnar formations were seen between the strata of pre-Cambrian sandstone in the mountainsides, to which they had made their way in the liquid state shortly after the great folding movement took place 300,000,000 years ago, when mighty forces were still at work in the earth's depths.

On October 15 the sun appeared on the horizon for the last time that year at Brønlunds Fjord, and we entered upon four-and-a-half months of darkness so completely separated from the rest of the world that our nearest neighbours—ten men—were as far away as the distance from Edinburgh to London and the next again as far as from London to Marseilles. Slowly the daylight waned while blizzards piled drifts of snow against the house until they reached the roof on the lee side. Every three hours, day and night, the wireless operators made their weather observations, and flashed their reports to Denmark every six hours. The botanist measured ground-temperature and snow-cover, the geologist and the surveyor made locations and magnetic measurements. Only the glaciologists went further afield to their tent-camp at an altitude of 3300 feet on an inland glacier, the conditions of which were kept under observation.



A. J. Thornton

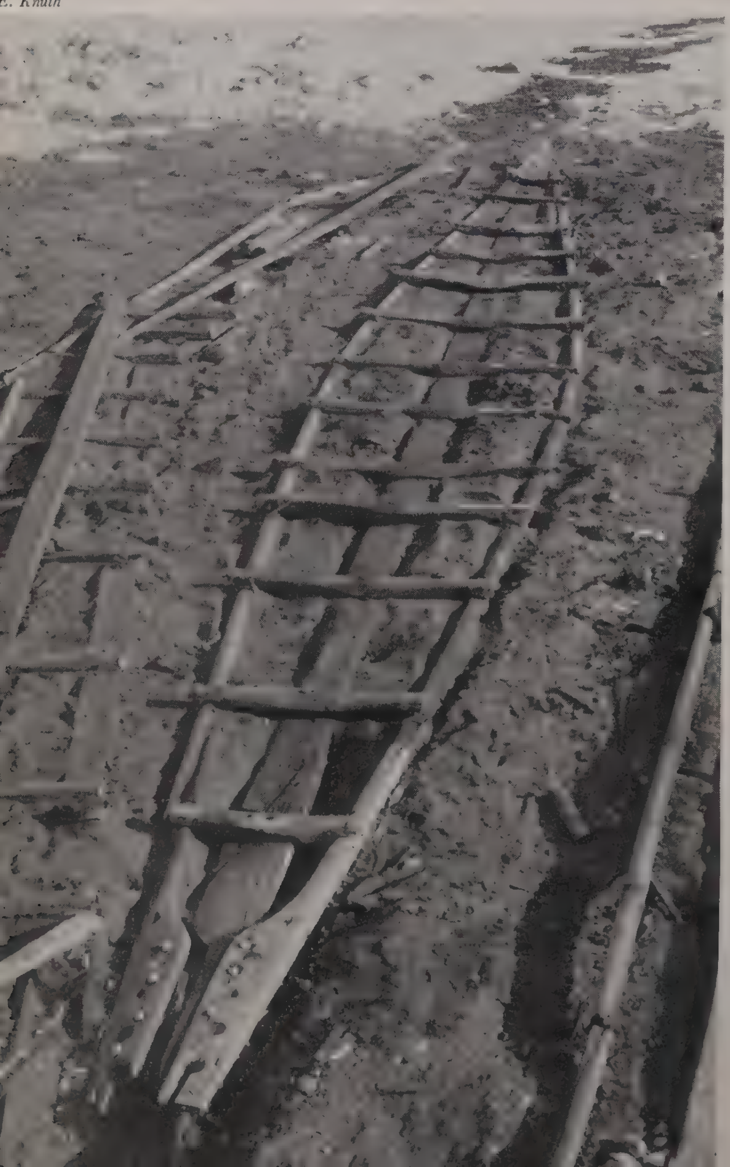
In the winter 1948-49 long blizzards followed one another with only a few days' break; during some the wind attained a force of seventy miles an hour and more than ninety-five in the gusts. In 1949-50 the blizzards were fewer and much less strong but, on the other hand, February and March last year were much colder than the year before, culminating with 44° below zero Centigrade (47° Fahrenheit) on February 28, 1950. In theory the sun should return on February 28, but on account of the mountains it did not actually shine on us by the fjord until after the first week in March and the sun itself was first seen on March 8. For barely a month and a half the sun rose and set in its normal way, and on April 9 it was clear of the horizon and circled in the sky above us continuously until September 5.

For the long daylight period between April 9 and September 5 a greater number of sunny hours were recorded than the average for a whole year in Denmark—and this abundance of light may well compensate animals and plants for the handicaps of darkness and low temperatures in the winter. It was curious to note that in summer Pearyland had no night frosts for two-and-a-half months and that the mean temperature for July was several degrees Centigrade above recordings made five degrees of latitude (345 miles) further *south* in North-East Greenland, where they have night frosts practically the whole summer. The absence of frost is the principal reason for the fact that although the ice on Brønlunds Fjord is about seven-and-a-half feet thick in May, it breaks punctually in July every year—a fortnight before the South Base eight degrees of latitude further south is free of ice.

When daylight had returned the various scientists started their field-work in earnest, first on the month-long sledge journeys in the spring and later, after the thaw had set in towards the end of June, on walking tours in the neighbourhood of Brønlunds Fjord. The botanist collected some 400 species of the Pearyland flora, 90 being higher plants and the rest mosses and lichens. The zoologist's material included numerous skulls and whole skeletons of mammals, about 100 birds representing 21 species, and 1500 samples of microscopic animals, while the archaeological material filled ten large crates.

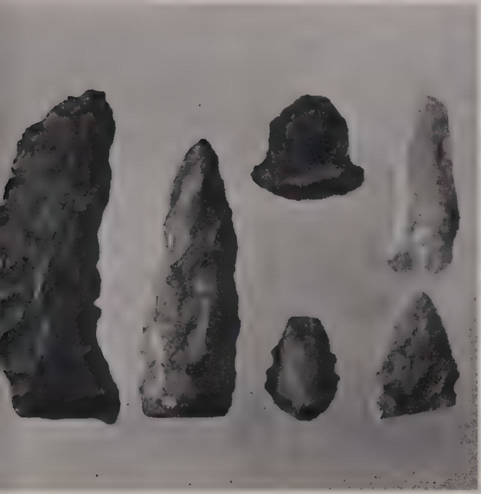
It may sound strange that we speak of archaeology in Pearyland, and our expectations in that respect had not been great, but we were pleasantly surprised. Pearyland has been a transit place for Eskimos on their wanderings from Arctic Canada to North-East Greenland, and there were traces of two different civilizations corresponding to two immigrations, the people of which had stayed in Pearyland at different times. Evidence of the first inhabitants was found in Brønlunds Fjord, where the ancient

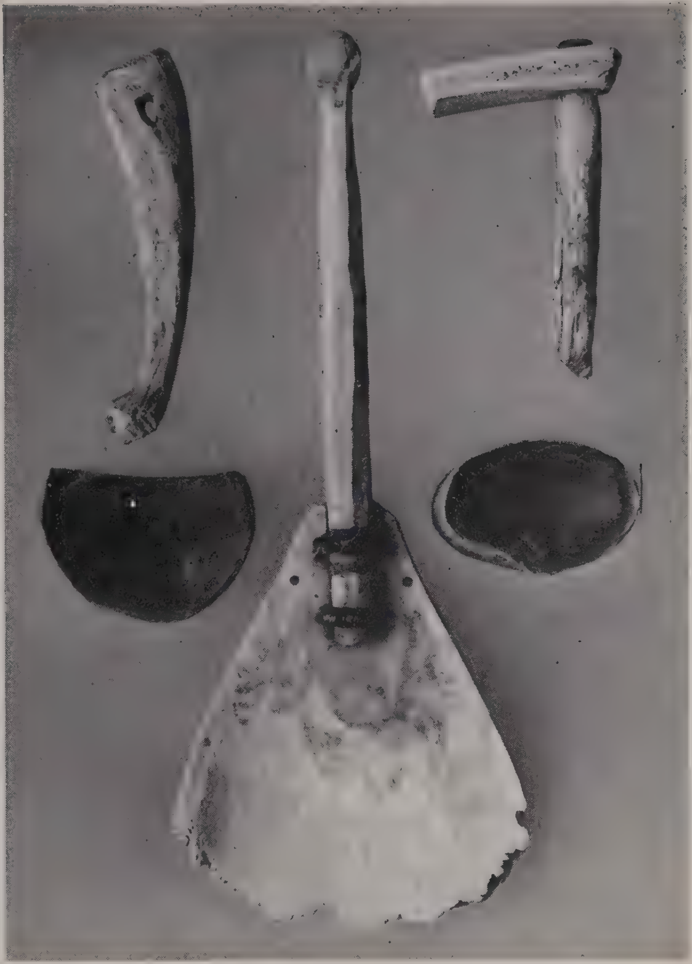
E. Knuth



Pearyland afforded some startling evidences of human habitation: one of these was the framework of a thirty-five-foot Eskimo whaling boat belonging to the "Thule" culture of about 200 years ago

(Right) *Other objects belonging to the "Thule" culture, found with the whaling boat, were an adze-handle, a snow-shovel, a blubber-pounder, a meat-tray and a baleen cup. The objects told of a 'coastal' population who hunted large whales at the northernmost settlements of the world during this chapter of their history.* (Below) *Dating from an earlier period—perhaps 600 years ago—were knife-blades, a pointed axe-head, scrapers and a weapon-blade, all flint implements of the "Cape Dorset" culture, Greenland's oldest known Eskimo culture*





Eskimo tent camps were more numerous than elsewhere, so much so that it seemed as if our new capital had accidentally been built just where the capital of Pearyland had been in ancient times. The Eskimos at Brønlunds Fjord were an 'inland' population who lived chiefly by hunting reindeer and musk-oxen, supplemented in spring by trout-fishing at the river mouths. They belonged to the so-called "Cape Dorset" culture and may be guessed to have inhabited Pearyland from 500 to 600 years ago.

The most sensational archaeological find made by the expedition gave evidence of the next Eskimo immigration. It was a well-preserved and almost complete skeleton of a thirty-five-foot whaling boat which protruded from the snow at Herlufsholms Strand on the flat south-east point of Pearyland, 125 miles from our winter quarters. At camping sites near this, under a thick layer of snow, many beautiful articles were found quite different in size and kind from the small objects of flint from Brønlunds Fjord—articles typical of the second Eskimo culture in Greenland, the "Thule" culture.

In the spring the glaciologists made short sledge-journeys for the purpose of studying glacier-types different from that kept under regular observation. Their investigations confirmed the theory that the ice is receding and proved that the milder climatic conditions noticeable in many places in the northern hemisphere also include Pearyland. Many sledge-journeys took us into fjord-systems hitherto not visited by white men, and these journeys as well as the summer's air-trips yielded quite a few geographical discoveries. The cooperation between dog-sledge and aeroplane was characteristic of this particular expedition to the extreme Arctic regions. With its airborne winter quarters it broke new ground for research work, and with its 6000 miles of sledge-journeys this, perhaps the last of the great sledge-expeditions in Greenland, carried on traditions of its predecessors. The future will belong to motor sledges and helicopters.

Waters of Persia

by P. H. T. BECKETT

Last year's Oxford University Expedition to Persia received a grant from The Geographical Magazine *Trust Fund. It worked in the Kerman basin, which lies at about 6000 feet in the south-east of the country. The team, comprising a geographer, botanist, zoologist and soil-chemist (the author), made land-use maps and studied local plant ecology and the fauna of the* qanat *tunnels*

SEATED among a circle of friends in a garden by night, while the tea is passed in silver-mounted glasses and the talk moves easily, it is not difficult to feel with the mind of the poet—

> Alas that Spring should vanish with the Rose!
> That Youth's sweet-scented Manuscript should close!
> The nightingale that in the branches sang,
> From whence, and whither flown again, who knows?

—who must himself have been singing and laughing in just such a garden.

About the lamp are the guests, their faces white in the light. Round, where the light can hold back the darkness no further, are the moving shapes of the women, and the shining eyes of the little staring children. From beyond is the sweet scent of the night flowers and the murmur of running water. Above the stars are bright and clear, "and that is why our village of Jupar is so high". The defence against the dark is so frail, and the comradeship is only for a night, so life itself becomes ephemeral.

Beyond the garden walls is endlessness, broken only by the camel-bells, as the camels which in the stillness of the night seem as if they must be the bearers of poetry from a golden city shuffle by and then disappear into silence, and the cry of a night bird. And by day there is the bare desert, the *biyábán*—the waterless place where there is no rain from spring to autumn—with the loneliness of empty space, and the oppressions of an extreme climate and the tax-collector.

The Persian gardener opens his garden, like his heart, only to friends. In it he has made security and comfort against the outside, and it is the haven towards which he may turn, the end of travels. Round his heart he has built a wall, to protect it from the intruder and from the merely curious. Above the wall are the heads of the trees—the tall poplar, the green-and-white chenar or Oriental plane, the red-blossomed pomegranate and the dark-leaved cypress—seen from across the waste as a pledge of greater mystery within, and the enticement of a refuge.

Running through the garden is the stream, whose sound is a background to the noises of the night. And the garden derives from the stream, wrung from the desert to hold back the desert.

Always in Persia the mountains stand behind the desert, red between the blue sky and the buff earth. Here is the heaviest rain, and in winter the snow, and on the flatter slopes is the thickest vegetation. The tussocky mats of prickly herbs grow quite close and their cover provides shelter for brilliant black-and-yellow spiders and small animals of the field. Between the plants there is little soil and so the water from rain and the melting snow runs off quickly, scoring gullies and waterfalls as it goes.

In the high basins and the valleys where the stony floor has gathered a little soil, and the flow of the water through the porous gravels and sands is impeded by some rocky sill or collected in a hollow, there are the little mountain villages, each with its well and stony fields. The stones laboriously gathered from the fields serve to hold back the terraces against the rains and floods of early spring. Above the villages on the tops are the sheep and goats, brought down to the fold at night and guarded by shepherds against panthers.

Following the valleys down one comes below the mountains to the foothills. These are gravelly and bare, so that the rain draining off the mountain soon sinks down below the surface of the land, and with a few exceptions it is only at the end of winter when the gravel is saturated and the flow is great that the stream-beds are filled with running water flowing out onto the plain over a broad fan of gravel.

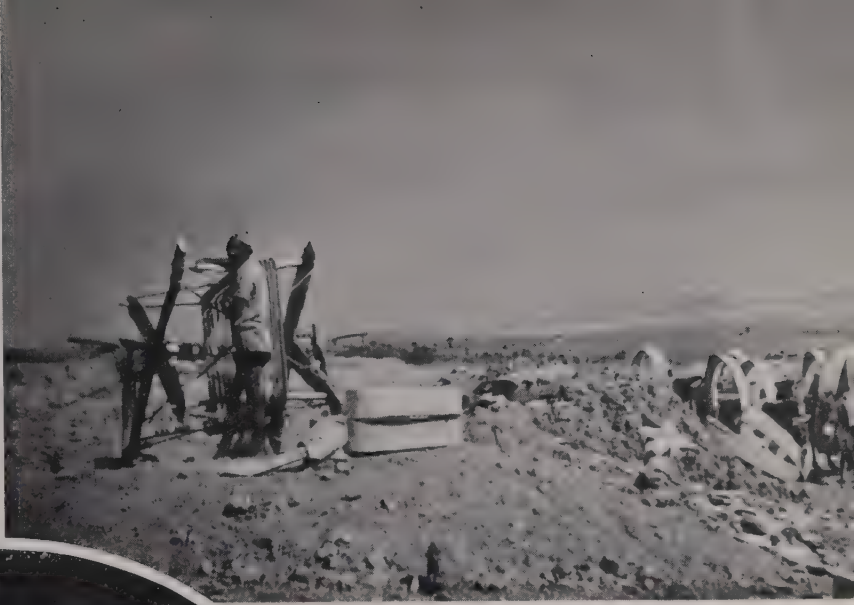
Here, sheltered from the winds and the winter cold of the mountains, are the lesser villages, such as Karun-sara-Sang ("refuge among the stones") and Baharistan ("country of the Spring"), sited in the valleys where the water from the mountains is less deep than elsewhere. Like those among the mountains the people see little of the government in the form of officials or *gendarmerie*, and so being isolated they are independent and well able

The gardens of the Persian plateau exist only in virtue of water brought to them by man. Within their walls are shade, comfort and security; outside them lies the endless desert. (Above) *Through a door the water-channel comes; astride the stream and rising above the watered garden's walls are trees—cypresses, planes and pomegranates: none elsewhere.* (Right) *The protecting walls are constructed of mud. Sometimes a winter cloudburst, or a thief, may cause part to collapse, but rebuilding is easy*

All photographs, except four, by the author

The 'desert' in Persia extends from the edge of one irrigated and cultivated area to another. This biyábán, *almost useless for lack of water, is covered in part with dunes and the rest with stones and coarse gravel.* (Left) *The desert's natural vegetation of tough, scrubby bushes is grubbed up and brought on the backs of donkeys to the villages for fuel. Now little is left.* (Below) *Higher up in the hills, where there are fewer people and more rain, some grazing remains for sheep and goats*

Water is life to the villages of eastern Persia, but lies too deep below them to be raised easily from wells in quantities sufficient for irrigation. Instead a "mother-well" is dug near the mountains where it is less deep and the water is led from the foot of the shaft to the surface along a level tunnel or qanat



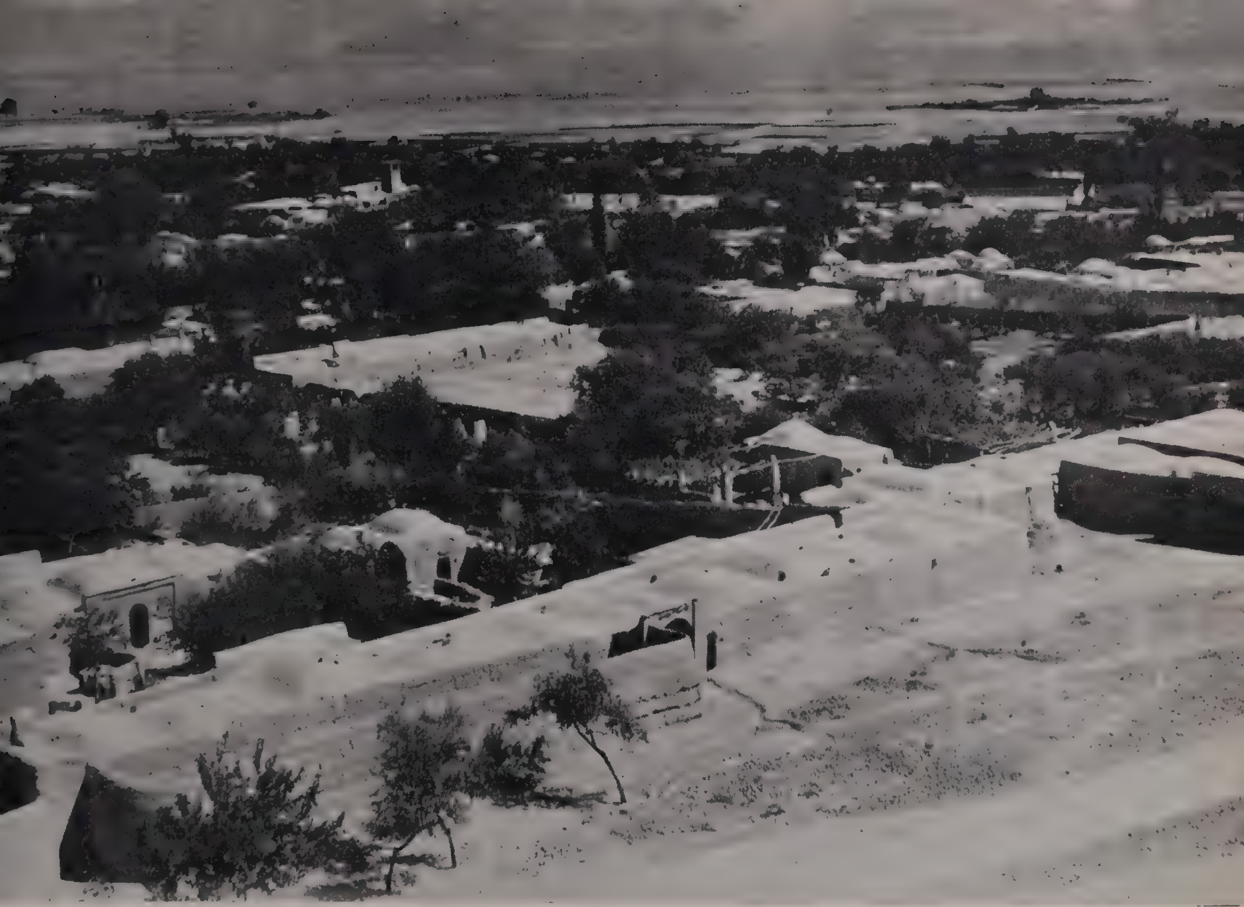
Every fifty yards along its length, up to twenty miles or more sometimes, a shaft gives access to the tunnel from the surface, providing ventilation. (Above) *A team of two men clearing a qanat: one works the winch which raises sheepskin bags of silt, filled by the man below. In soft ground the tunnel is supported by fire-clay rings baked on the spot.* (Left) *An Oxford zoologist standing in a qanat beneath one of the ventilation shafts*

(Right) "*Where the water flows from the tunnel into daylight is the focus of the village*". *From this point the stream divides into channels serving different parts of the village, then it is led through one garden after another, eventually flowing to the fields below. The nearer the field the more likely it is to be watered and so to bear crops*

Eric Gordon

"*Always in Persia the mountains stand behind the desert*". (Above) *In their high, stony valleys fields are terraced where there is water enough to support a small village. Water, near the surface, comes from a well.* (Below) *In the foothills is better land and more water, and the villages are therefore larger—*

Eric Gordon



Eric Gordo

—but the water lies lower and is brought by a short qanat. On the plain are the largest villages. Here the good soil, washed down from the mountains, stretches to the dark edge of the desert, with a gentle slope convenient for irrigation: the qanats, however, must be long and deep

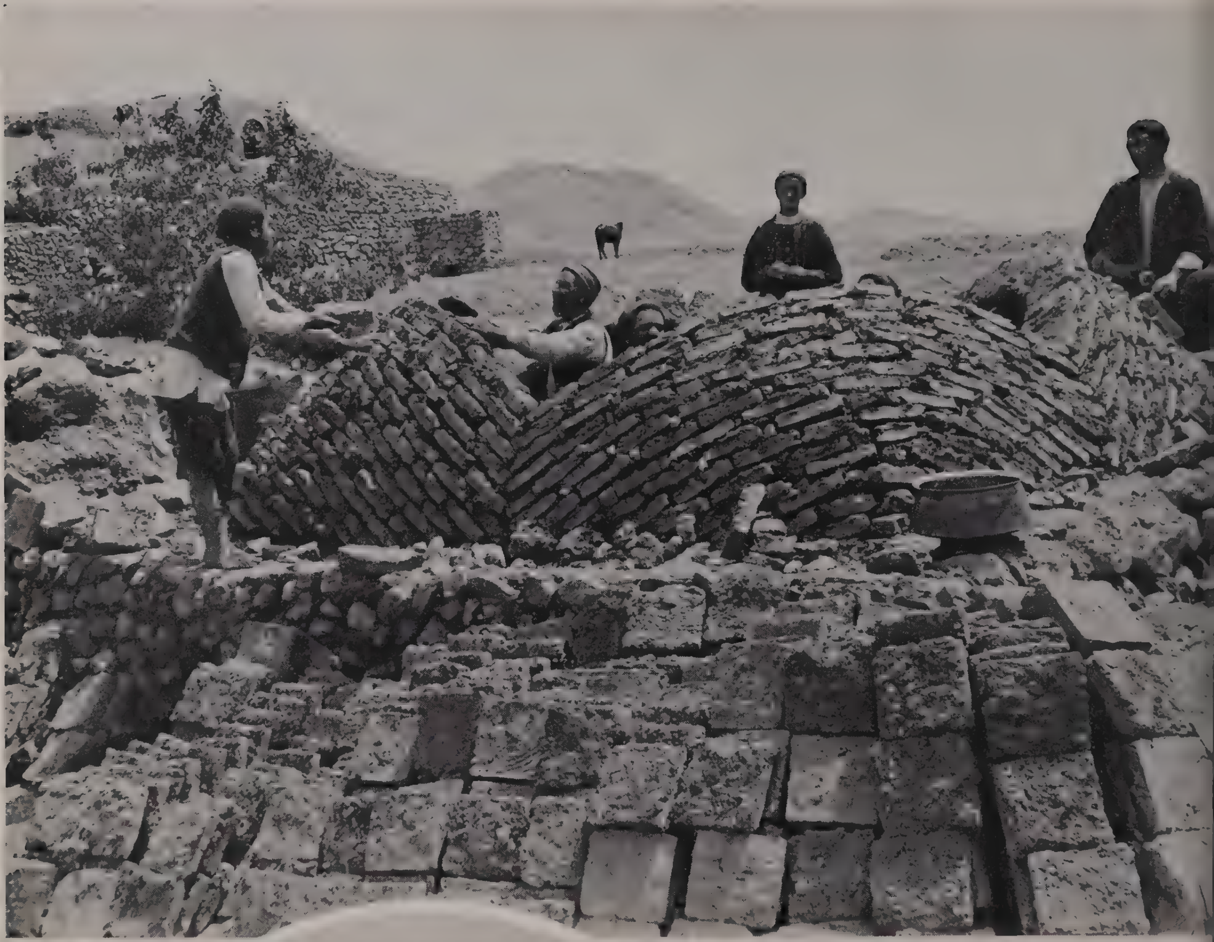
to manage their own affairs. They keep their herds among the hills, and in the valley bottoms grow corn and vegetables for their food, and opium for cash. In the houses the people with no land make carpets from the wool of the sheep, dyed with colours from mountain herbs. Only the cotton yarn which is the foundation of the carpet, the wooden frame on which it is made, and the design which is such an important factor in the value of a carpet, come from outside. Carpets like opium are good products for isolated villages such as these, since both of them have high value for small weight, and so make adequate return to pay for their carriage to the market.

From one village to another pass the caravans of donkeys, taking the carpets and opium to market, and pilgrims off to a shrine dragging behind them the reluctant goat that will be eaten to celebrate their safe arrival. "It is a hard life, always travelling!" complained one old driver as we rested to make tea at midday under a broad chenar, "I have nine children and two donkeys, and what will happen to us when the donkeys die?" His eldest son, aged fourteen, was along with us to look after the second donkey.

Below the villages the foothills merge into the plain, and here at the fringe of the outwash from the mountains, just so far that only the finer materials carried by the spring flood have not been deposited higher, there is good deep soil free from stones, and with plenty of gently sloping land suitable for cultivation without steep terracing, but with slope enough for the irrigation water to flow the whole length.

So along this border between hill and plain is a fringe of larger villages, their surrounding lands nearly joining, and above the roofs of the houses the blue dome of a mosque or the bigger house of the landlord whose village it is. In the larger of them will be small bazaars, providing workshop and market for the tinsmith and blacksmith, carpenter and gardener.

In one large village the bazaar was derelict. It had become the property of the *Waqf* or charitable trust, and "whenever property becomes Waqf it brings bad luck" as the last remaining tenant told me. This is not entirely



Eric Gordon

In the isolated villages of Persia, where communications are difficult, the people are independent, with little interference—or help—from outside: growing their own food and trading in such local products as opium and carpets, which, having high value for small weight, can be easily carried on donkey-back. In the summer the donkey-drivers are on the road and there is plenty of work for the builders in mountain villages exposed to the weather, as the houses are constructed of mud-bricks. (Above) *Building a roof-dome.* (Left) *Drivers loading up a donkey-caravan for the market* superstition, for Waqf land is more subject than most to litigation and chicanery, with interference in the work of the tenant; and leading in one case I knew to actual confiscation of a crop for the duration of a dispute, which badly damaged the credit of the tenant who had borrowed money on the surety of his harvest.

The water seeping through the gravel bed is deep below the surface, and therefore where the gullies from the hills come out onto the plain, and the flow of the underground water is strongest, wells are dug. It would be hard work to raise water to the surface from the deep water-table in quantities sufficient for irrigation, and so from the foot of the shaft of the first or "mother-well" is cut out a horizontal tunnel or *qanat*, along which water flows to the surface. The digging is a skilled job, with its craft passed down from father to son; and often walking across the gravelly plain the traveller may see a group of men with their winch, at the head of one of the frequent ventilation-shafts, winding up sheepskin bags filled by their comrades with silt from the floor of the tunnel.

This craft may be followed by a blind man; and it is an eerie sensation to wade up a tunnel behind the glare of an electric lamp and find a hoary workman digging away at a tunnel in blackness, perhaps singing softly to himself. Most of the workmen use oil

Carpet-making is carried on by women, or the men for whom there is no land. The weavers have almost finished this carpet. Between them a woman, the pattern before her, chants it row by row

At harvest time all the villagers of Persia seem to be out helping in the fields. Everything is done by hand: after the cutting (with a sickle) and the winnowing the grain is sieved from dirt

lamps, burning locally-produced vegetable oils, and sooty patches on the tunnel roof show where they have been working. Where the tunnel passes through soft sand the diggers set up an oven, and over a fire of desert scrub bake rings of fireclay to line the walls.

At the point where the water flows from the tunnel into daylight is the focus of the village, the source of life, since from here comes all the village water. The landlord, who is the owner of the qanat, with responsibility to keep it in good repair, will generally have some way of dividing the flow into several different channels. In Jupar the main flow is divided as it passes through five parallel sluices at the Panj Ab—the "place of five waters"—in reverse to the Indian Panjab, where the five rivers unite before flowing together to the sea. Then each stream will flow from one garden to the next, under the wall of one and through the door of another, swarming off other streams as it goes. Each gardener has his allotted share of the water, and for so many hours a week he may divert the whole flow of his stream over his beds. For the rest of the week he may take what he will with a bailer, but may not cause the water to flow onto his garden from its channel. In fact no gardener ever has as much water as he would like, and a lot of engineering takes place in the darkness, of

Then it is ready for weighing by the landlord's agent and the traditional division into his and the peasants' shares. From their slender store the peasants spare some for the waiting beggars

which all traces will be removed by sunrise.

With life the water also brings death and disease, as it carries the offal and dirt from one housewife to the next, so the wise householder fills his tank of drinking water early in the morning while the water is still clear.

When the village has been watered the streams run to the fields, where each patch is carefully levelled and surrounded by a mud embankment to hold in the irrigation-water. Every patch is watered one day in twelve, as the ditches are opened and closed in turn. Near the village there is ample water, and the fields are tilled every year. But further down the flow will only reach the fields at the desert edge in a wet year: here the plots are fallow for five years out of six. At this distance from the houses the melons and grain are very vulnerable to thieves, and parties of children with a few of the older girls build shelters of sticks and watch the crops as they chatter and play.

The bare desert surrounds the fields, cleaned of all its vegetation by the charcoal-burners. It is not long since the green scrubby thorns grew to within sight of the roads, but now there is none, and the sand-dunes are blowing downwind onto the fields. Across the wastes are lines of shafts, showing that below there is a qanat bearing water from the desert to gardens perhaps twenty miles away. Kerman was watered by qanats all of this length coming from one edge of its surrounding mountain basin, from mother-wells 250 feet deep or more. And past the lines of shafts go the lorries bringing merchandise and passengers, and slow trains of camels from Meshed and the Gulf.

From the plain one looks up at the mountains over the square pattern of the yellow fields, chequered with green crops, and over the mud-domed houses. For where timber is scarce it is an extravagance to use wood for rafters. At the time of the harvest for the different crops, between June and September, all the people seem to be out in the fields, cutting the ears with a sickle and piling them on a hard-packed threshing floor, where two oxen will draw a wooden toboggan round and through the heap until all the grain is free from the ear. Then in the afternoon wind the grain and chaff together are tossed in the air, and all along the line of the fields are puffs of white as the men work away, until in one heap is the chaff and in the other is the grain, requiring only to be sieved.

Among the peasants are the beggars who come out from the town at this season, bringing their empty bags, which they must fill if they are not to go hungry through the winter. They are all here: blind old women with neither husband nor sons, leaning on their daughters' shoulders, 'dervishes' chanting of Kerbela, and travelling musicians singing of Rustum and the wondrous heroes. By their heaps of grain the peasants stand strangely shy. Only on this day of the year have they such a store from which to give to these people even poorer than they, and there is reward in giving. But even thus the peasants will have so very little for the rest of the year that just a handful is a sacrifice as it is given.

Once the grain is threshed the landlord or his overseer takes his share, in return for which he has 'provided' seed, and water and the land, and from which he will pay the taxes. Round Kerman and in the South the landlord's share of all crops but opium is three-quarters, and four-fifths if he provides draught animals as well. The cultivation and harvesting of opium is more laborious than that of other crops, and so unless he is prepared to pay for extra labour at these times the landlord takes only half.

Nowhere in the world is a rent- or tax-collector popular as he goes about his work, and here even less than usual since his mulct is so large. There is a story current about a donkey, who was braying loudly and disturbing the rest of Allah.

"Curses upon you, miserable animal. Why must you make this noise?"

"I am your humble servant, Lord!" replied the donkey, probably placing his hoof over his right eye in Persian fashion of obeisance, "I was only cursing at the tax-collector!"

"Oh! In that case carry on!"

Then after the climax of the harvest life returns to its level routine. The builder continues to make houses, the blacksmith returns to his forge to make files and spades out of broken lorry-chassis, and the weaver to his loom. In one village a kid was being fattened up for a feast at the end of September to celebrate the finding of the Ram in the Thicket; in another was a funeral as an old man was returned to the desert which had been pressing in on him and his for sixty years, and now could press but lightly.

And always morning and evening the muezzin calls from the tower of the mosque, and the name of God is passed from village to village round the plain.

But all is not well, and the peace of the gardens is threatened. Fields are being covered and villages deserted as the sand-dunes are blown from the desert. Some of the qanats are failing, and landlords are not repairing others as they silt up or the roof falls. Some rich men dare not invest their money in new qanats, for fear of unrest, when the only good property is that which can be snatched up in flight. So the water is failing and land is going out of cultivation: walking along the edge of the village lands furthest from the houses I found many acres that can have borne no crop for ten years at least, and now the only signs that they were ever cultivated are low ridges, where before were banks to keep in the irrigation-water. Meanwhile the population increases, and the carpet industry which in better times would have provided work for the landless men is dying in the face of currency restrictions and import quotas.

So many men have neither regular work nor hope of finding it. The subsistence margin is so narrow, even when there is regular work, that for the workless there is despair.

There is no feeling of affinity, I think, towards Russia, which has long been an enemy; and anyhow there must be many men like an old ditch-digger on the plain, who had been working in Tashkent when the Bolsheviks began to collectivize Central Asia. But in despair any new promises from new creeds may sound more hopeful and less spurious than the old.

Religion and Art in Tibet

by FOSCO MARAINI

This is the second of two articles, each with a photogravure section, of which the first appeared in our July number, relating the part played by religion in the life of the Tibetan people to the Tibetan environment and the expression of religious ideas in Tibetan art. The author has twice visited Tibet. His book, Secret Tibet, *widely noticed and commended in its Italian edition, is to be published in English by Hutchinson and Company with sixty pages of his remarkable photographs*

ART of secular periods or secular civilizations has its roots deep in the world. Benozzo Gozzoli may, in theory, paint the Magi's progress, but in practice he is portraying the gloriously beautiful life of an Italian court of the 15th century; through Monet and the Impressionists Paris has passed into the spiritual core of Western civilization; and the mists of Fuji, its terrifying lights under storm or moon, the patient toil of the half-naked peasants, the gaiety of the *machi*, the village street, will remain eternally alive in the prints of Hokusai or Hiroshige.

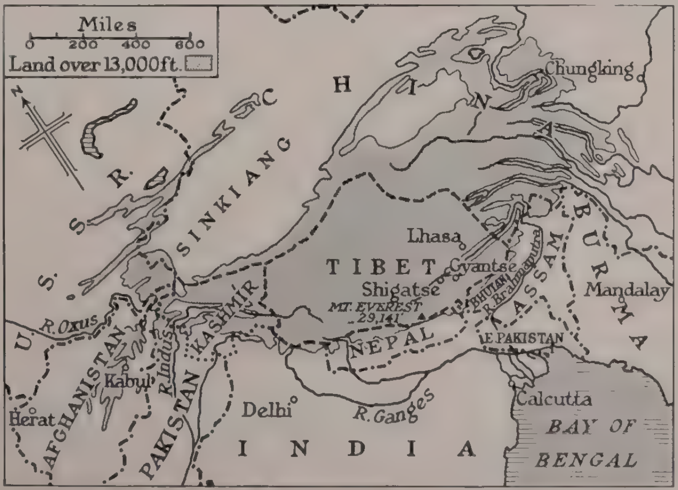
Religious art instead is often out of time and space. Byzantine mosaics are similar from Kiev to Palermo, and Buddhist sculpture has a fundamental inspiration from Sarnath to Kyoto. For the truly religious man, living his transcendental visions, the world is merely an incident in the eternal scheme of things; hence the art he favours deals with essentials, with great myths, with supernatural beings and their courts of angels and saints, their cohorts of enemies, demons or goblins.

This applies strikingly to Tibet. Perhaps in no country is there such a total independence of the inner from the outer world; of the dreams and the myths from the stones, the sky, the trees. Outer Tibet is one of light and simplicity, of clear horizons and great solitudes, inner Tibet is a mysterious, obscure and fantastically complicated labyrinth of disquieting symbols and bewildering initiations; outer Tibet is made of rocks, earth, ice, space, clouds, inner Tibet teems with erotic suggestions and metaphysical bloodshed; outer Tibet is cold and bracing, a land of skin-clad or wool-clad nomads, inner Tibet is hot and sultry; nude gods sit under curious canopies or dance abstractedly, ritually interwoven in strange nuptials, holding flowers and jewels, drinking blood from cups made of human skulls.

Architecture belongs to outer Tibet; its megalithic geometry of cubes is a noble and beautiful element in the landscape: Tibetan architecture is a powerful architecture of men. The simple horizontal lines, the vast empty spaces without decoration, the slanting walls rooted solidly in the mountainside, the sober use of colour are all elements of harmony with Tibetan natural scenery: they suggest the monumental and elementary shapes of the crags, the skyline of the lofty mountains, the freedom of hill and valley.

It is only on entering a temple that we pass from outer to inner Tibet; physically because the shadowy and mysterious depth is engulfing us, spiritually because the clear and simple world of Asia's plateaux has turned into the tangled and disconcerting world of Mahayanic Buddhism. The darkness of a Tibetan temple is something solid, living, ancient; it is an active darkness, not just a passive absence of light. Active and buttery, sensitive and fat; a quivering nocturnal plasma where anything might take place.

As our eyes get used to the new conditions,



A. J. Thornton

and start perceiving the scanty light reflected here and there by statues and paintings, we shall certainly notice the serene countenances of the Buddhas and Bodhisattvas of meditation and beatitude, but we shall also notice fierce and horrid-looking monsters dancing in obscene attitudes, surrounded by flames, brandishing miniature corpses, or riding grotesque mules in lakes of blood. It is important to state at once that these awful beings are not demons, but great and holy Bodhisattvas who take such terrifying appearances to fight the forces of ignorance and evil. Hence ugliness and horror are saintliness and piety. All is new and startling. We are moving in a totally alien atmosphere.

Spiritually Tibet is fossil India. The works of art we see in a Tibetan temple are the material expression of an inner world born, matured and mellowed far away in places surrounded by steamy jungles, where an overwhelming vegetable and animal vitality displays at every instant the crudest realities of birth, hunger, love, suffering and death. Inner Tibet is fossil forest, fossil heat, fossil moisture, and fossil languor in a land of ice and ancient stones polished by the wind.

Thus Tibetan art is fundamentally Indian art, though various other influences are also traceable. First of all there is a Greek element which cannot be overlooked. Primitive Buddhist artists never actually represented the figure of the "Illuminated One". In the great *stupas* of Bharut and of Sanchi the whole legend of Buddha's life is represented without showing the figure of the Master. A baby elephant represents the Conception, a lotus flower the Nativity, a horse with no rider the Great Departure, demons and courtesans near an empty seat the Temptation, a tree and a seat the Illumination, the "Wheel of the Law" stands for the Predication and a stupa for the final Nirvana.

It was only at a later period that the Graeco-Bactrian sculptors of Gandhāra, a region of North-West India now partly in Pakistan and partly in Afghanistan, began to represent the Saviour as a "trim, smug-faced Greek Apollo, posing in the attitude of an Indian Yogi" (Havell). The traditional figure of Buddha can thus be said to represent a synthesis of Greek and Indian interest in man: man as a person for the Greek element; man as a category, as a stage in the vast drama of cosmical redemption, for the Indian one.

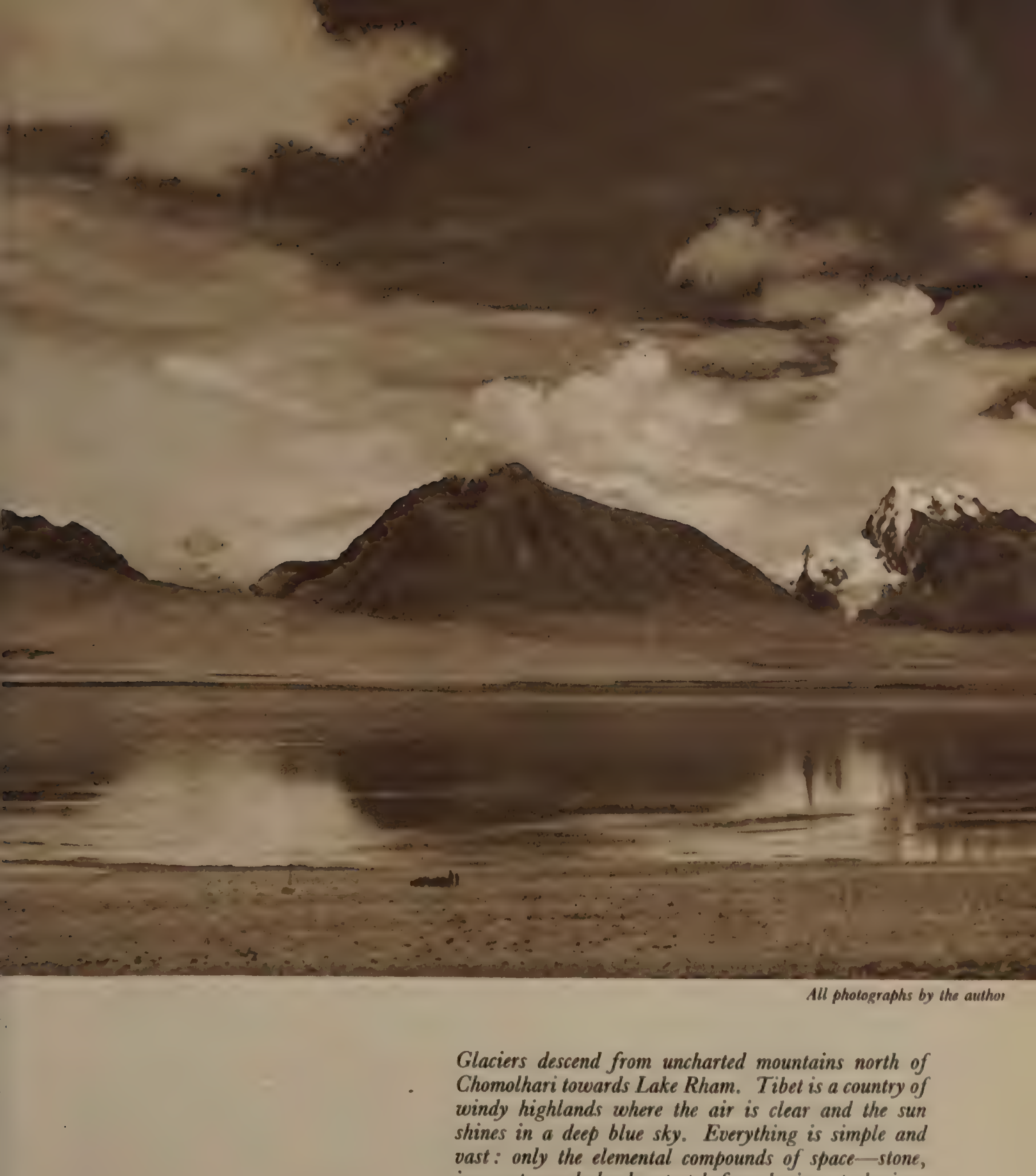
Eventually the Indian element showed by far the greater vitality. Later Buddhism developed an interest more and more keen in Buddhas as entities, thus submerging Buddha, the historical person, in a multitude of celestial creatures. The formal and artistic representation of these varied only slightly; the Indian mind was not so much interested in personality (history) as in symbols (metaphysics): only minor iconographic differences told the initiate if he was in front of Amitabha, Akshobhya, Maitreya or Sakyamuni.

Next to the concept of Buddha it was the concept of Bodhisattva that soon took an enormous importance for the followers of Mahayana Buddhism. A Bodhisattva is in many ways an intermediary between the Absolute on one side and on the other the haphazard course of *samsara*, the world of becoming, of life, death and decay, where man is born and reborn. A Bodhisattva is the aspect of divinity which is nearer to living beings; though a Bodhisattva could retire to the unending bliss of nirvana, he consents to be reborn in the flesh for the benefit of all "living things" (*sem-chen*).

While the figure of a Buddha is fundamentally that of a yogi, of a saintly beggar, a Bodhisattva is represented as a young Indian prince. The body itself represents totally different ideals. A Buddha has the rounded trunk and the soft limbs that result from long immobile meditation; a Bodhisattva is youth and the joy of action, strength and beauty. Naturally these qualities are not represented with realism, but poetically suggested by a certain width of the shoulders, by a narrow waist and long graceful limbs. Realism as such has no interest for Eastern artists, their goal is always the transfiguration of Nature according to an ideal.

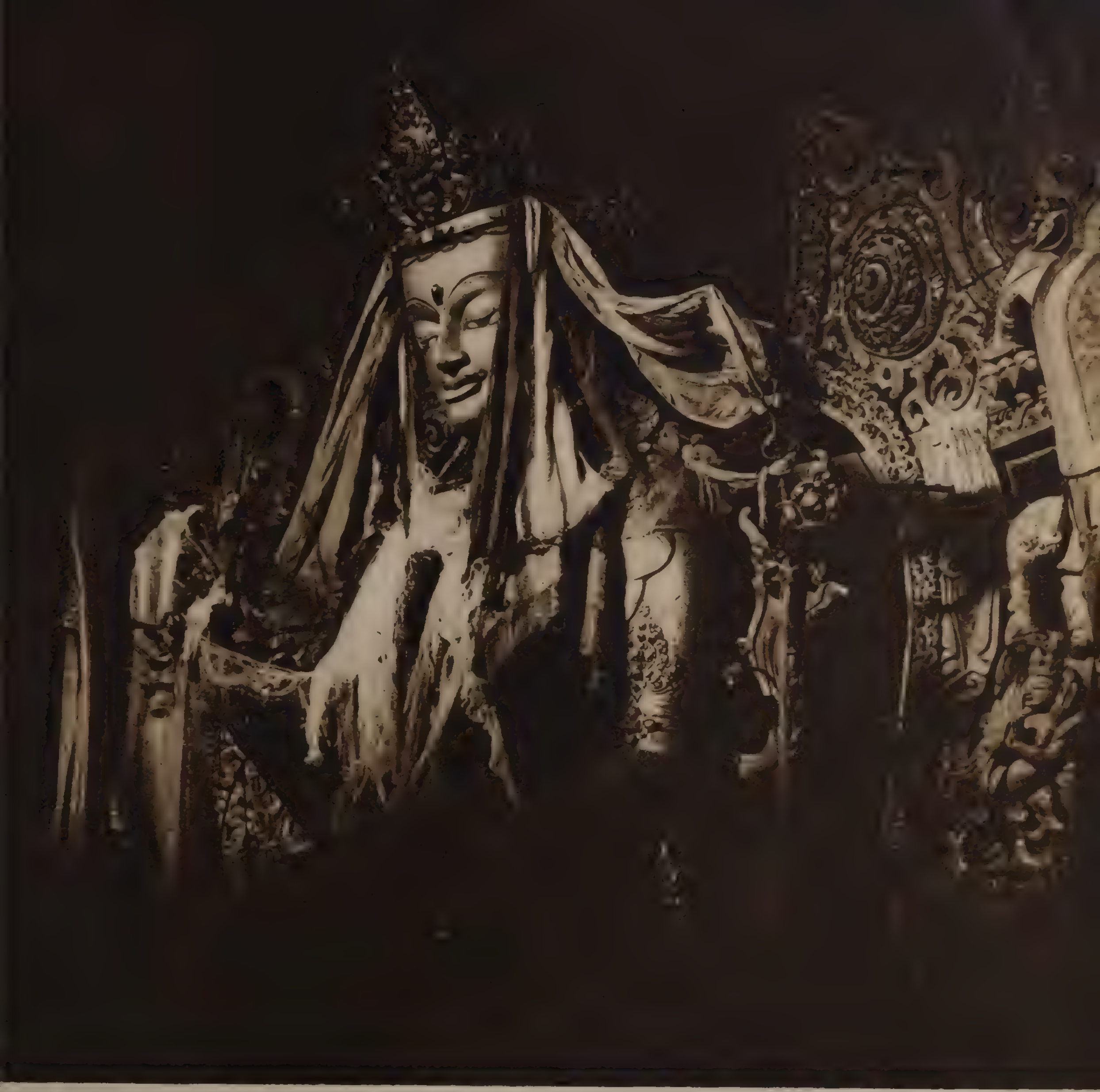
This principle is consistently followed when, instead of youth, beauty or peace of mind, they represent lust and hatred, savage passion and bloodthirsty ferocity, as is the case in paintings and sculptures of deities in "angry", "fierce", "terrific" attitudes. While Buddhism, in its long career, became more and more overcharged with magic, with the adoration of female energies, with the highly seasoned cults of Tantrism, the artistic expression of these strange intuitions and far-fetched ideas also became enormously diversified. Gods were represented not only in calm (*shi-wo*) and fierce (*tro-wo*) attitudes, but united with their Female Energies (*shakti*) in orgiastic embraces, symbolic of deep philosophical truths.

When this overripe form of Buddhism reached Tibet it found there in full sway the primitive Bon religion, a variety of north-Asiatic shamanism, with Manichaean in-



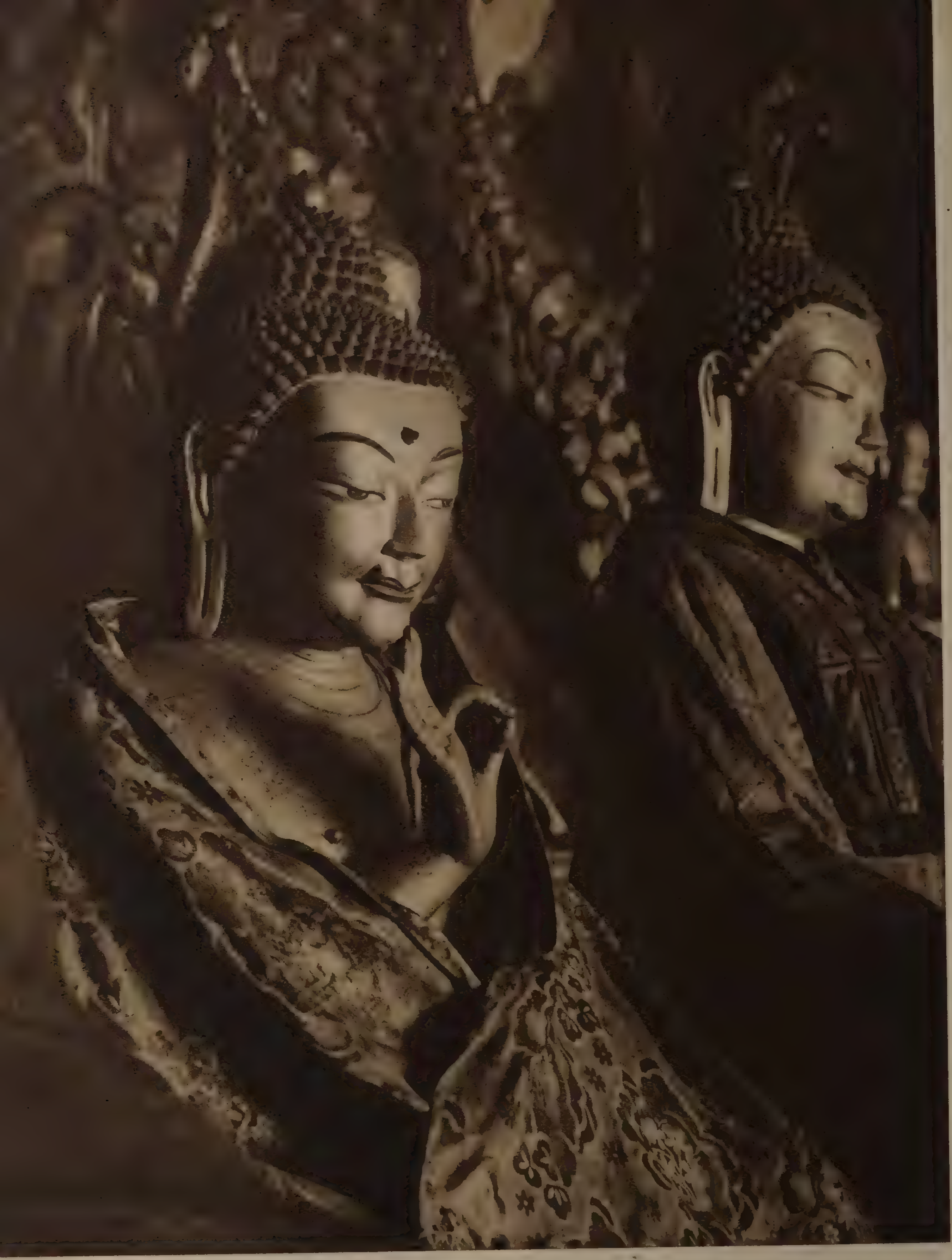
All photographs by the author

Glaciers descend from uncharted mountains north of Chomolhari towards Lake Rham. Tibet is a country of windy highlands where the air is clear and the sun shines in a deep blue sky. Everything is simple and vast: only the elemental compounds of space—stone, ice, water and cloud—stretch from horizon to horizon

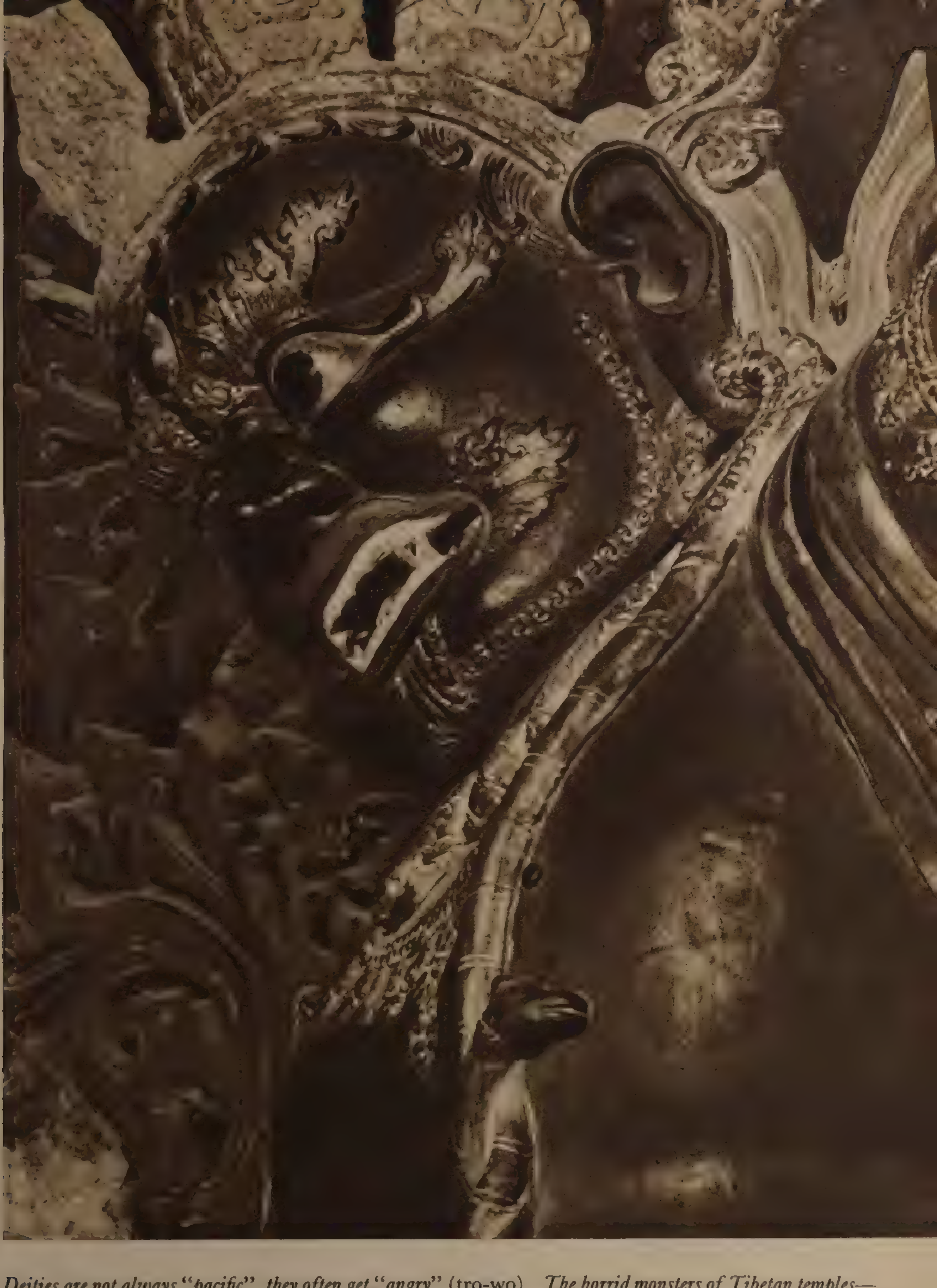


(Above) *But within a Tibetan temple a dark and mysterious depth will engulf us : everything will seem strange and uncanny, totally unrelated to the brilliant atmosphere outside. Perhaps a large golden statue of Buddha crowned as a Bodhisattva will loom on high. The only light in the place is a beam descending on the forehead of the god*

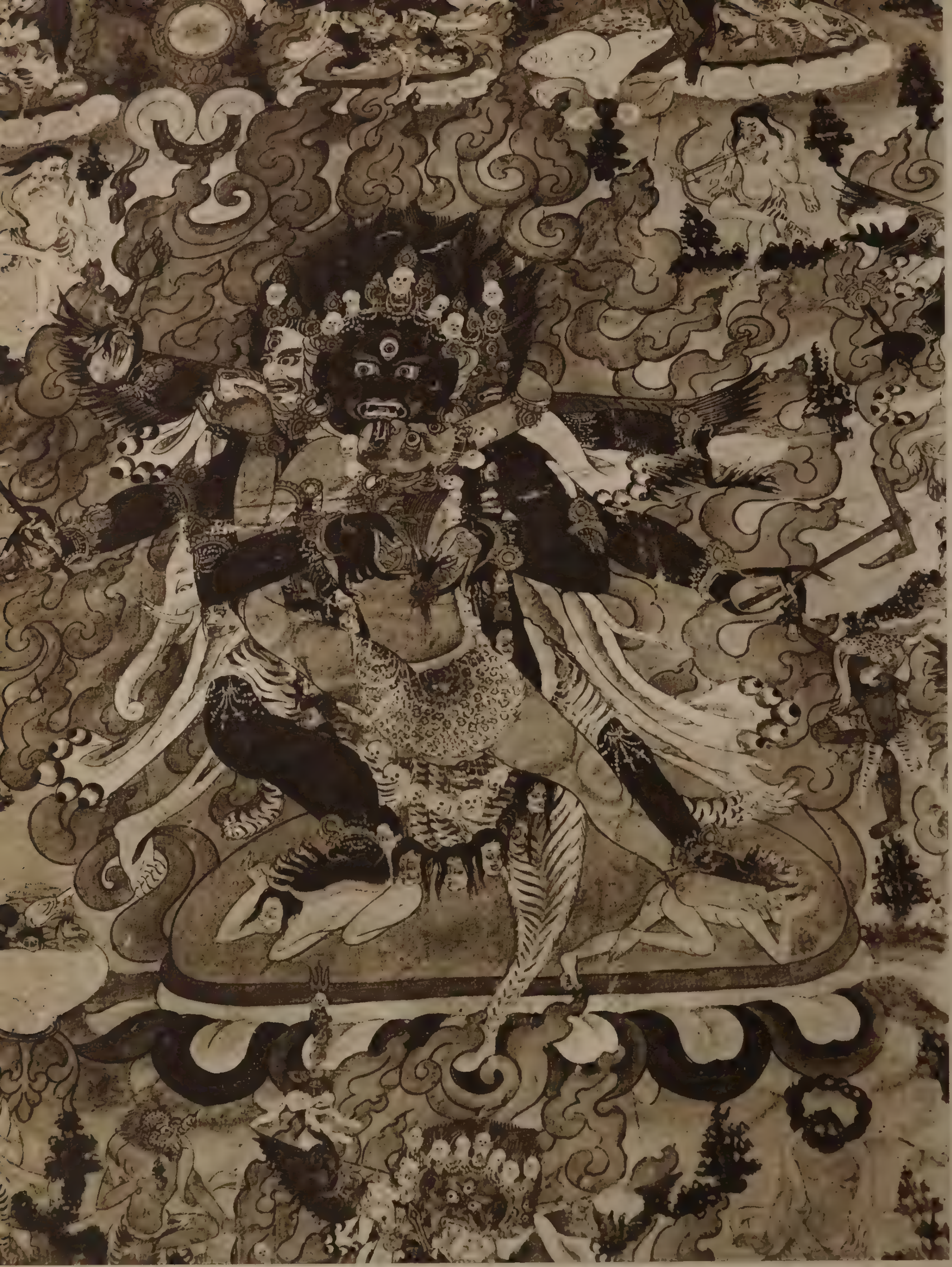
(Opposite) *Tibetan architecture is perfectly in harmony with the landscape. The simple, monumental proportions and the turreted outlines of monasteries and fortresses seem to suggest the sky-line of the lofty mountains surrounding them, as here in the Sacred Enclosure of Gyantse, among temples, chapels and treasure-houses of the lamas*



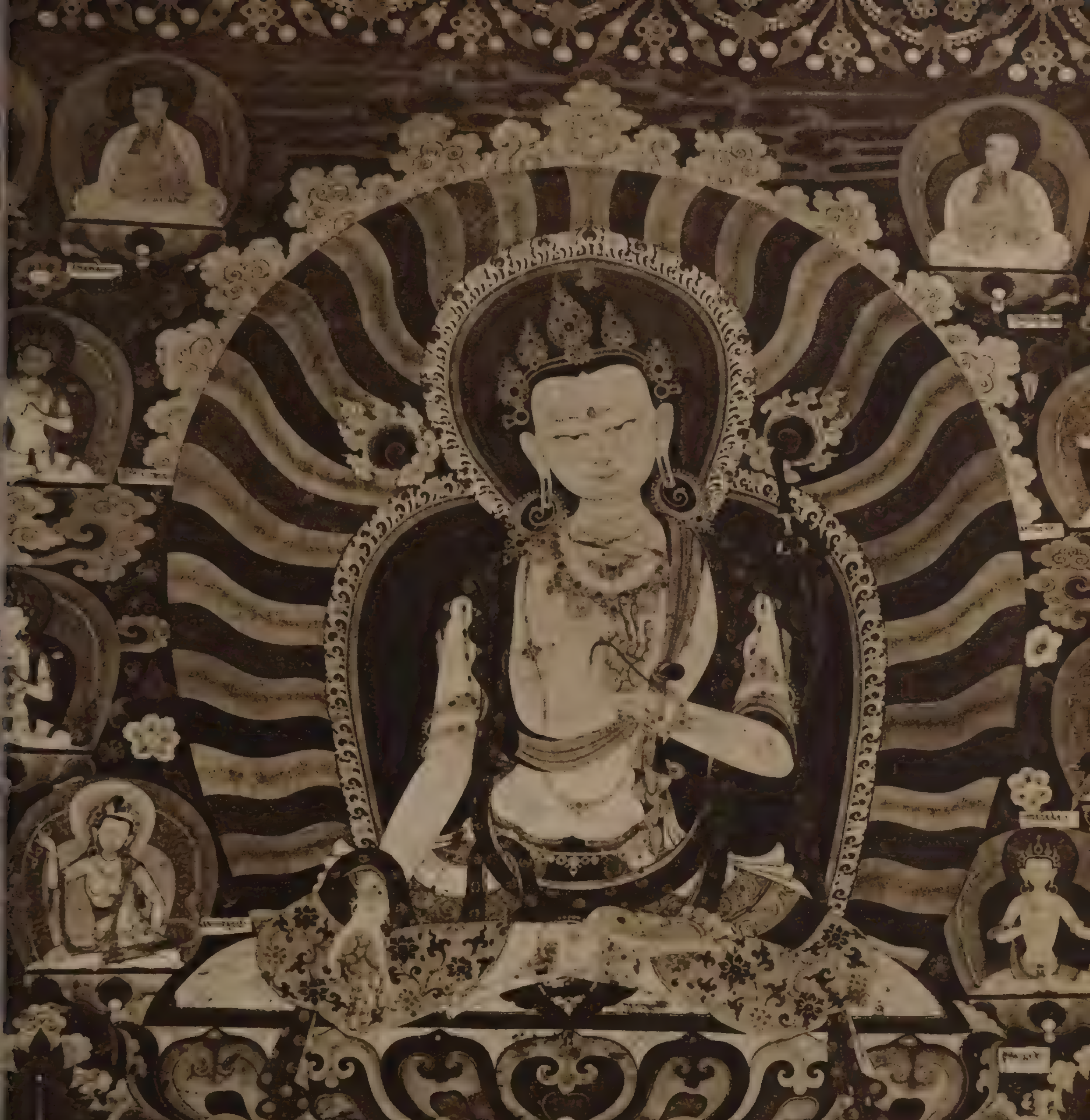
The figure of Buddha was not represented in religious art till a strong Greek humanistic influence made itself felt through the Graeco-Bactrian kingdoms in north-west India. The Tibetan figure of Buddha is thus a synthesis of Indian and Greek interest in man and represents the shi-wo *or "pacific" attributes of deity*



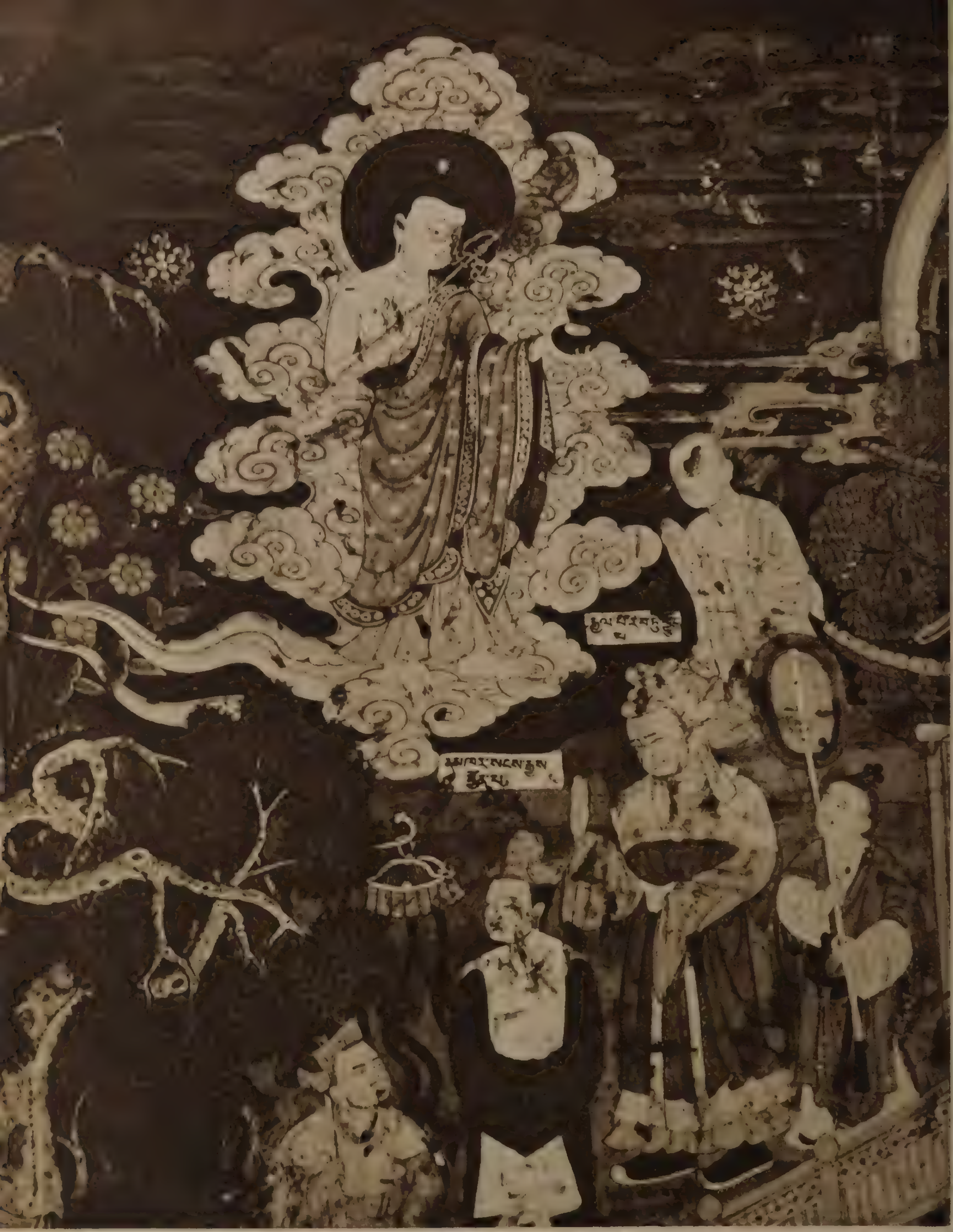
Deities are not always "pacific", they often get "angry" (tro-wo). *The horrid monsters of Tibetan temples—which Tibetan artists have a special genius for portraying—are rarely demons, but mostly forces of light and goodness that take on these ferocious aspects to terrify and subdue the manifestations of evil and ignorance*



Later Buddhism developed a weird passion for magic and the adoration of female energies : new cults found their place in this complex religion and art borrowed from Hinduism the forms with which to express a whole range of new ideas. Gods were represented in "pacific" or "terrific" attitudes and clasped in orgiastic embraces



ndian influence is fundamental in Tibetan art. Celestial beings—like this beautiful Bodhisattva Samantahadra of a 14th-century fresco in the great Kum-Bum pagoda of Gyantse—have always been represented as young ndian princes. A supple body, covered with jewels and silks, relaxes gracefully in a regal attitude of mercy



In many later Tibetan paintings a certain Chinese influence is seen. This is particularly noticeable in the details of the landscape, in trees or mountains, and in figures representing human beings. Man is no longer a metaphysical symbol but a person in history, with the costumes and gestures of his time fluences. From all surviving records it seems that Tibetans of this period (7th-8th centuries A.D.) were a cruel, bloodthirsty race. There is a famous passage from the poem *Kesar of Ling*, translated by Sir Charles Bell, in which a soldier of Ling describes with relish the tortures he is going to inflict on a spy of Hor who has just been captured. Human sacrifices were also very frequent.

It took a long time for the new religion to abolish the ancient ceremonial butchery; but the older propensities found a wonderful medium of expression in many motives of Indian Tantric art, and have left a permanent trace in the painting and sculpture of Tibet. Gods in their terrifying aspect hold human skulls as drinking vessels filled with blood, or they brandish impaled human beings, or disport belts of human heads hung by their hair: the offerings at their feet are most probably human hearts, or human eyes or human vitals. Just as the sensual delight in the naked human form passed socially from life to art in the transition from pagan to Christian Europe, so the savage pleasures of cruelty and blood followed the same course in the transition from Bon to Buddhist Tibet.

It is interesting to note the different fate of Tantric Buddhism in two widely different countries reached at about the same period: Tibet and Japan. In Japan it remained more or less confined to the adepts of the Shingon sect, in Tibet it conquered the whole country. Sir Charles Eliot considers that this is due to "the artistic nature of the Japanese which seized upon the nobler and not the more superstitious side of the new religious system". In Tibet, instead, Tantrism found a most congenial atmosphere. The magic cults, the exoteric symbolism based on terrifying and sexual elements, the fantastic contortions and the grotesque nuptial feasts of fiends and monsters seemed to take there a position even more important than the one they held down in the plains of India.

An old legend tells how Padma-Sambhava, the saint who introduced Buddhism to Tibet in the 8th century A.D., fought innumerable demons and sorcerers all over the country, but then spared most of them on their consenting to become defenders of the faith "while he on his part guaranteed that in return for such services they would be duly worshipped and fed" (Waddell). Here is a poetical version of a very important historical fact: the survival of a strong native (Bon) element in Tibetan Buddhism.

In the migration from areas populated by Indians (with their traditional genius for metaphysics) to an area populated by a Mongoloid stock (with its genius for organization and empire) Buddhism practically ended its evolution as a great philosophical venture and started its career as a Church. As regards art this meant that the true creative period was over; canons, iconographical indexes and set cycles took the place of invention.

To this day Tibet has remained like a glorified Mount Athos. Up in the monasteries of the Greek peninsula Orthodox monks go on painting icons in the Byzantine style; in Tibet artists, lay and ecclesiastical, repeat the motives of Nepalese art or those developed in Northern India during the Pala and Sena periods (8th to 13th centuries A.D.).

A typical Tibetan banner painting (*tang-ka*), of the sort that is often seen in European and American collections, frequently shows all or nearly all the principal elements of Tibetan art. At the centre there may be a Bodhisattva, his youthful limbs covered with jewels, his body with flowing silk of many colours, his head crowned with a golden diadem. Above him there will probably be a small Buddha, possibly the spiritual "father", in a posture of meditation, his body shorn of all ornaments and covered by a simple cloth. To the right and left of the central and principal figure, and beneath it, there will be the strange and varied court of gods in fierce attitudes, trampling on corpses in a red halo of flames, with diadems of skulls, with snakes and flayed skins of human beings around their green, blue, red bodies. There may also be fierce she-demons (*dakini*) with an expression of destructive fury, or couples of gods in father-mother (*yab-yum*) embrace. Lastly the idealized portrait of Tsong-kapa (1357-1419), the founder of the Yellow Sect, or of some other great historical figure, may have an important place of its own, while touches of imaginary landscape, painted with a delicate miniature-like technique, will give the whole assembly of gods a pellucid imaginary space.

And here comes another great influence acting on Tibetan art, the Chinese one. India stands for metaphysics and a language of symbols, for a strange dialogue of extreme sensuality and extreme abstraction: China stands for man; for man and his immediate surroundings, nature, houses, gardens, simple everyday objects. Both in their portraits of great lamas, and in their distant backgrounds of mountain scenery, as in the idealized palaces and gardens of legendary paradises, in the cult of the peony and in the love for light curly clouds, Tibetan artists have felt deeply the influence of Chinese masters.

The City of Worcester

by BRYAN LITTLE

photographs, except three, by A. J. Woodley

Bryan Little's The Building of Bath *proved him to have a discerning eye for the character of a city; he is now engaged on books regarding each of the "Three Choir" cities. Herein he writes about Worcester where that Festival is being held this year, which is also the tercentenary of the Battle of Worcester and the bicentenary of the founding of the world-famous porcelain works*

Of all the greater events of the Festival of Britain that are held in provincial English towns there is none whose origins and traditions go back so far as those of the Festival of the Three Choirs. It can be held, and can find a proud place amid the great cultural display of 1951, with no essential change from its normal routine, being an ancient, well-tried, natural growth that takes us back to the days when Bach and Handel were alive and when Queen Anne was only just dead. For it started with "Music Meetings" of the choirs of Gloucester, Hereford, and Worcester Cathedrals that may have been held as early as 1715. The Festival runs in rotation; this year, from September 2 to 7, it is the turn of Worcester. The city will therefore be specially prominent in 1951; it is worth our while to take a look at Worcester itself as the setting for this musical event.

I think it fortunate that it should have been Worcester's turn in this Festival of Britain year. All three of the cities have their special virtues and attractions, but on balance I am sure that Worcester is the finest of the trio. Moreover, it has in 1951 its own pair of specially important centenaries. Worcester porcelain is famous the world over; in June this year a visit from Princess Elizabeth commemorated the 200th anniversary of the founding of the company. A century earlier, in 1651, the Battle of Worcester was fought, and with the defeat and flight of Charles II came the end of the last futile Royalist hope of military success in the Civil War. The battle, and with it the beginning of Charles' historic flight, was on September 3, and its tercentenary will thus come during the Three Choirs Festival itself.

Worcester stands on the edge of the Severn, the oldest part of it on a low ridge that rises steeply from the river and lies amid the gently undulating, rich countryside of the Severn vale. Though Birmingham's outskirts lie a mere twenty miles away there is little hint of a great industrial area, and Worcester, though of some note in its own right as an industrial town, has more about it of a shopping centre and social rendezvous for a large country area. Its position is of great dignity: the river, a broad, deep stream, navigable both for pleasure steamers and for the large motor-driven petrol barges that come up from Avonmouth on their way to Stourport, runs close enough to the city for the Severn and its important bridge to be an ever-present part of the Worcester scene. No English cathedral is more closely linked to its river than Worcester, for a delightful terraced garden runs direct from the west door to a point immediately above the towpath, and Worcester Cathedral with its river at one end is among the most famous of all English views. So too is the great church famous as one sees it from beyond the Severn, whether it towers above a foreground of flood-water or from behind the beautiful county cricket-ground which is always the scene of the first match of such visiting teams as those of Australia and South Africa. Above the bridge the river swings westward, and there is room, between the northern end of the city and the river, for the "Pitchcroft" which is Worcester's long-established racecourse.

The city has, at times and in succession, been a minor fortress, the seat of its bishop and thus a place of religious activity, a county town and the scene of its own dignified civic life, a river port and the centre of varied industry. The older parts of it still make up a long, rather narrow town, for the most part to the east of the Severn though one old parish has always been on the other side. Much of Worcester's life has therefore always centred round one main street: the one highway that in its long course goes by a series of names. It is Sidbury as one approaches from the south, then College Street as it climbs the low hill that is crowned by the Cathedral. For most of its length it is High Street, The Cross, Foregate Street, and The Tything; the old gates have gone, but a reminder of the Fore-Gate is the railway bridge of the line to Hereford, a shallow arch

A scene that, more than any other, epitomizes England: cricket played against the background of a cathedral. The opening match against a visiting test-team, on the county ground at Worcester

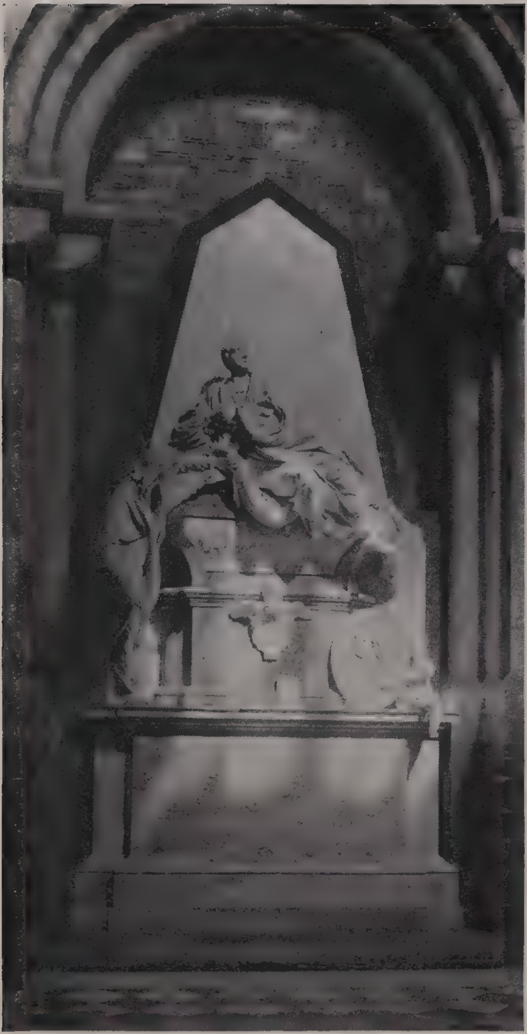
The Times

(Opposite) "*No English cathedral is more closely linked to its river than Worcester*" *: the view from the 14th-century tower.* (Above) *The Three Choirs Festival being held in Worcester cathedral*

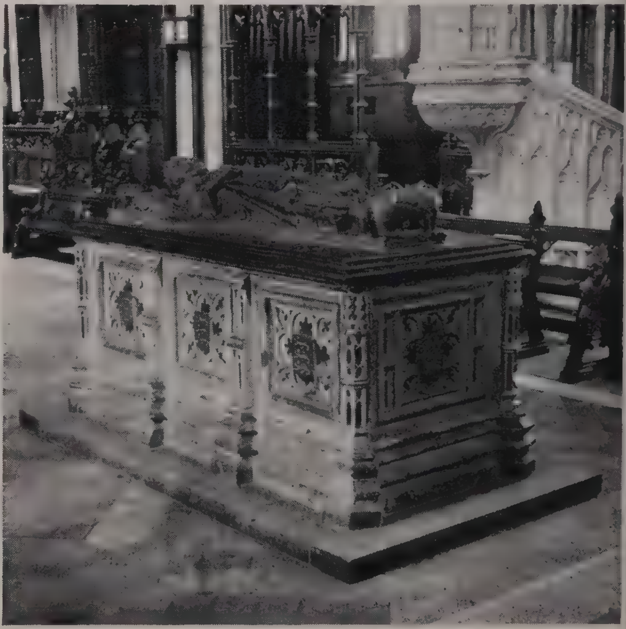
with a strong reminiscence also of the more recent past, for its centre is indelibly stamped, and still brightly coloured, with the London-cum-Bristol coat of arms of the old Great Western Railway. Here in this street, and in such parallel, less fashionable and therefore less rebuilt thoroughfares as the Shambles (still full of butchers' shops), Friar Street and New Street (with a particularly good group of very ancient half-timbered houses!) are the best of Worcester's shops. They are thronged, not only with Worcester's own people, but with shoppers from elsewhere in the county, for Worcester is the main shopping place for people from far around. But this long backbone of the city from Sidbury to The Tything is not all shops, and was certainly not all a shopping street a century and a half ago—within its length there were, and are, some subtle variations. At one end are the Cathedral and other buildings of a religious stamp, then comes a zone of civic activity, then a district of shopping and commerce, finally beyond the railway bridge an area that, for all its modern shop fronts, was clearly conceived as a district of fashionable Georgian residence.

Worcester has had a bishop since the 7th century. He does not live now in the city, but in the castle of Hartlebury some eleven miles to the north. But the Palace at Worcester still stands; for a time it was the Deanery and now it is being converted so as to form a Diocesan Church House and club. Near it the Cathedral dominates the southern end of Worcester. Beyond are the remains of the monastery buildings (for the Cathedral was served by Benedictine monks in the Middle Ages), the Close with its charming Georgian houses in mellow red brick, and the King's School whose Great Hall is the old refectory of the monks.

One cannot here do more than give the briefest sketch of so grand and historic a building as Worcester Cathedral. The outside, except for the splendid tower of the later



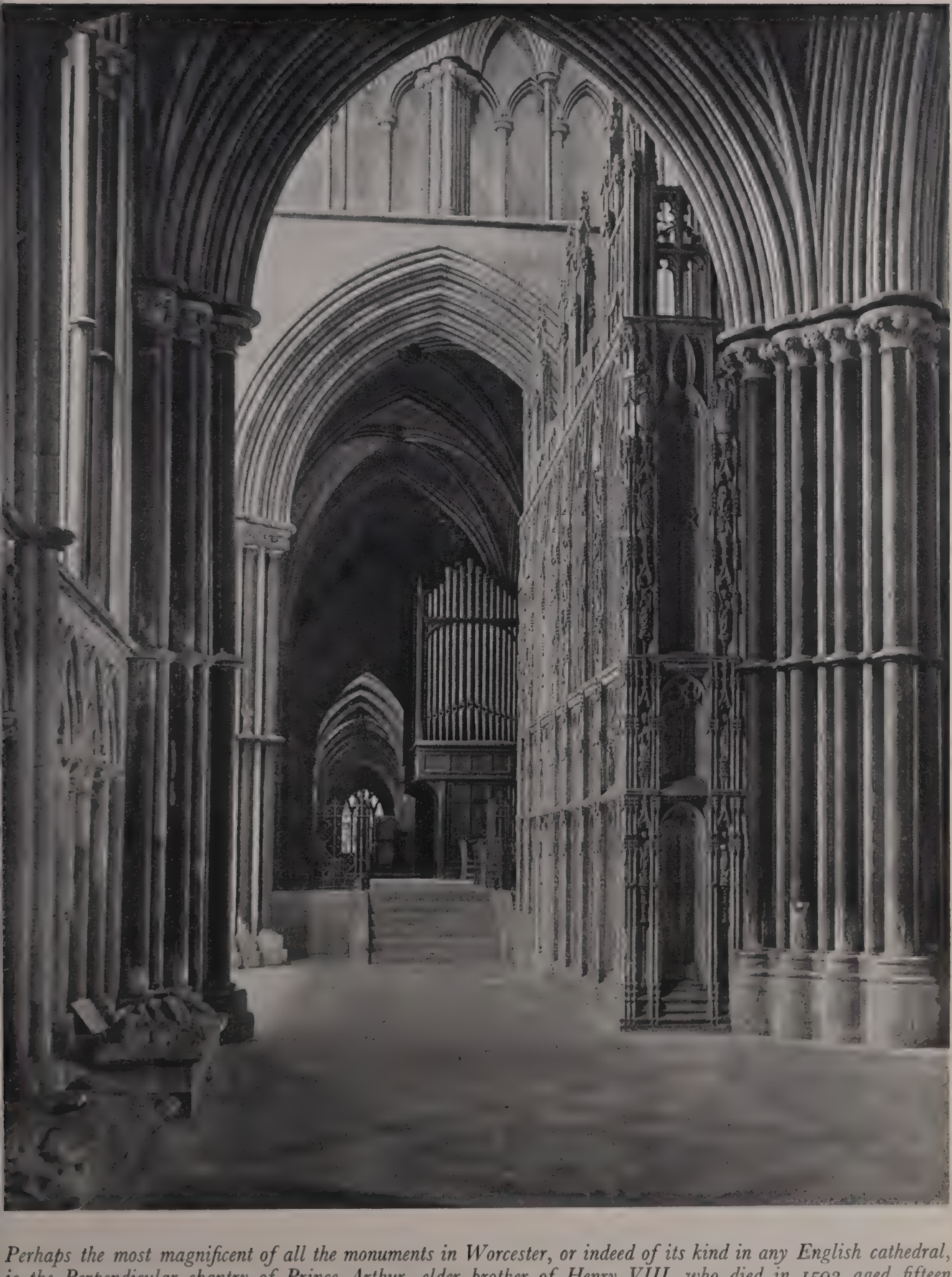
The monuments in Worcester Cathedral span the centuries. (Below) *The earliest royal effigy in the country is that on King John's tomb, which dates from about 1240, though the tomb itself is 250 years later.* (Left) *A masterpiece of Georgian Baroque by the sculptor L. F. Roubiliac commemorates Bishop John Hough who died in 1743*



14th century, is severe and a little disappointing, for the use of crumbling local sandstone has forced the builders of our own times to reface practically all of it with modern work. The glories of Worcester Cathedral are all within. Its architecture ranges through all the styles—from the early Norman of St Wulstan's crypt, through the 13th- and 14th-century Gothic of the choir and nave, to the exquisite late Perpendicular work of Prince Arthur's chantry chapel near the high altar. But the main fabric was complete by 1400.

Worcester Cathedral is notable for its tombs and monuments. There are many of them, and here I can do no more than mention three—two for historic, the third for artistic reasons.

King John was one of our least agreeable monarchs, but he was not everywhere unpopular, and he did his good deeds. He often stayed at Worcester and was a generous benefactor to the Cathedral. So when he lay dying he arranged to be buried at Worcester; his body was carried across from Lincolnshire, and lies now in the middle of the choir. The tomb itself is of about 1500, but the effigy upon it is from soon after John's death; it is the oldest of all our royal effigies in England. Near it is a far more beautiful, and in many ways a more historic tomb: that of Prince Arthur who died in 1502. For this was the eldest son of Henry VII and the first husband of Catherine of Aragon; he died at Ludlow aged only fifteen, and was buried at Worcester with great pomp on April 26 that year. The death of this Prince of Wales is one of the most significant events in all our royal history, for had he succeeded his younger brother Henry would never have become Henry VIII and much might have



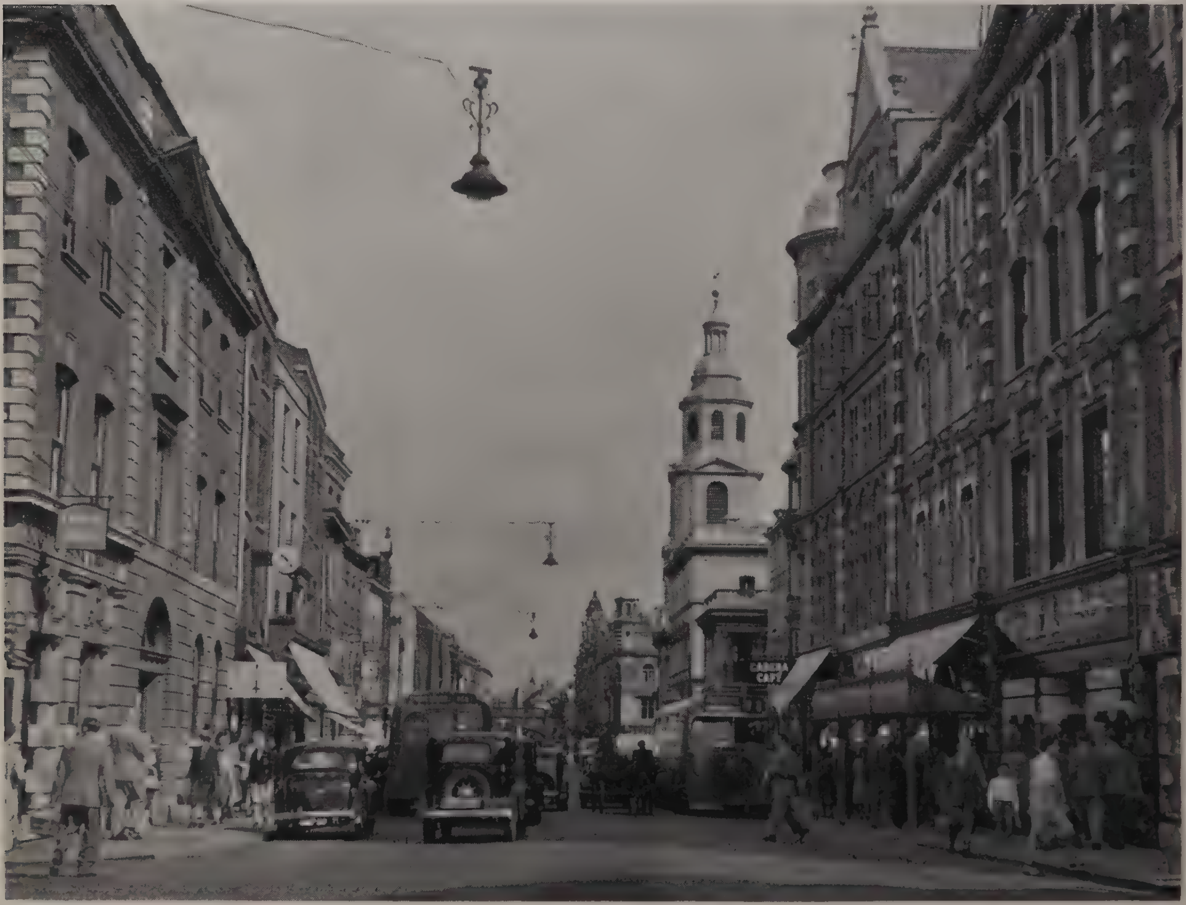
Perhaps the most magnificent of all the monuments in Worcester, or indeed of its kind in any English cathedral, is the Perpendicular chantry of Prince Arthur, elder brother of Henry VIII, who died in 1502 aged fifteen been different in our religious and political life. One may speculate without end on the possibilities; a certainty is the extreme beauty of the Prince Arthur chantry here in the Cathedral at Worcester. It is one of the loveliest of all such chantry chapels found in such numbers in our English cathedrals.

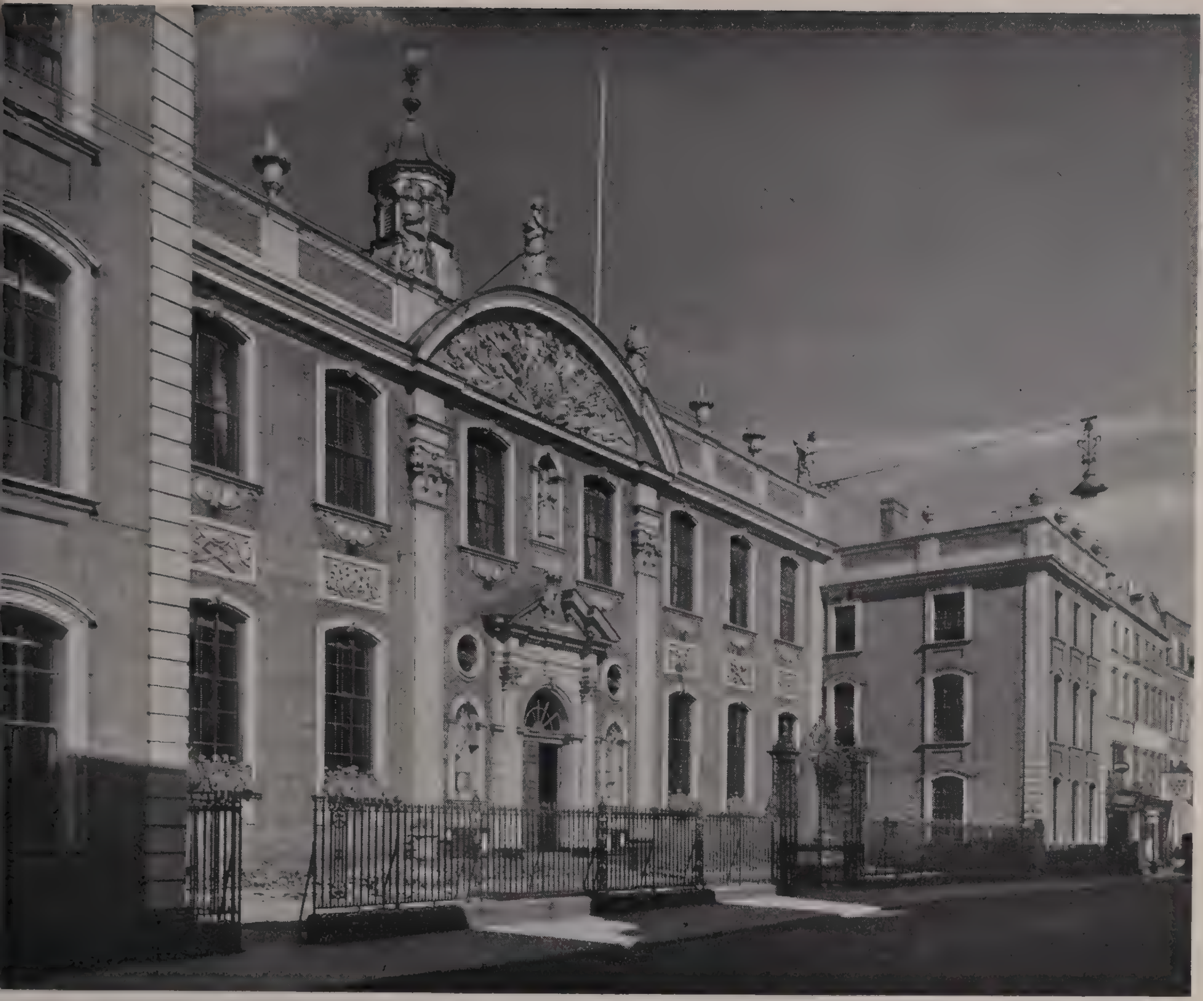
My third monument is that of Bishop John Hough. He died in 1743 and was bishop of Worcester in the early days of the Three Choirs Festival and at the time when it was first organized along its present lines. His monument is perhaps the best in the Cathedral—certainly the best of its Georgian memorials, and a masterpiece of the sculptor Roubiliac. On a sarcophagus and above the long inscription the figure of the bishop reclines in a living posture; as he gazes to Heaven his splendidly carved statue and its setting have about them all the dramatic, ethereal feeling of Baroque art.

The Cathedral and its mediaeval surroundings are very much at one end of the city; as one goes north one gets more and more the impression of a Georgian town, albeit there are many older houses behind the varied 18th-century fronts in their beautiful red brick. Moreover, Worcester was lucky in that century, not only in her famous glove trade and in her new porcelain works, but in the possession of a notable provincial architect, a late follower of the school of Wren named Thomas White. He it was who gave Worcester one of the finest Guildhalls in all England, and he designed two of the four Georgian churches that make Worcester richer than almost anywhere outside London in this kind of architecture. The city spread northwards; it was in that direction, in The Tything and later in such a Regency district as Britannia Square, that "fashion" and "elegance" found their place.

But since the 18th century Worcester has radiated outwards to allow for modern activi-

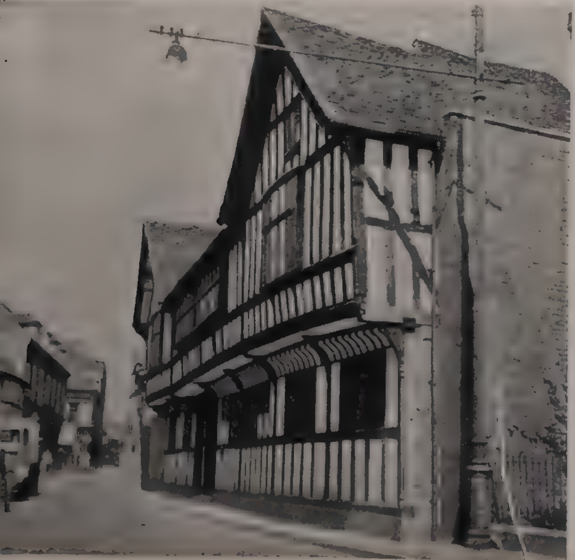
Worcester is the shopping centre for the countryside around; its streets are a symposium of architectural styles. One of its four churches dating from the 18th century is seen on the right

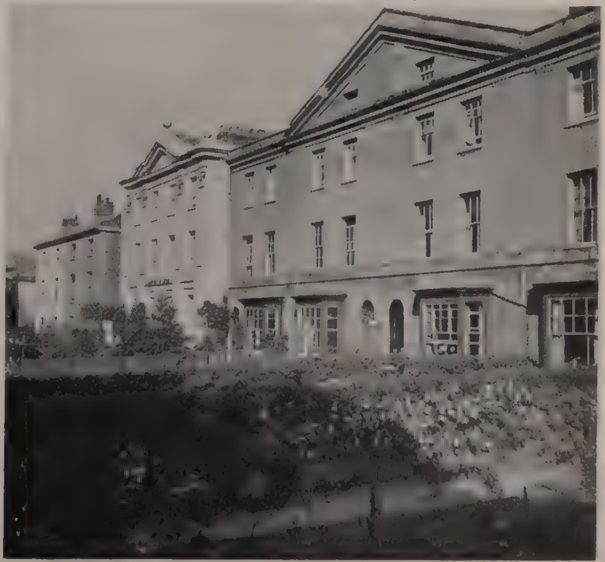




A. F. Kersting

\bove) *Worcester's most important Georgian building is the Guildhall, designed by a local architect, Thomas* *'hite.* (Below, left) *Half-timbered houses in Friar Street and* (below, right) *Regency ones in Britannia Square*





Crown Copyright

Worcester has many industries of which the most famous is perhaps the Royal Porcelain Works. The design of this plate was originally adapted from the Chinese soon after the firm began

ties and a growth in population to the present census figure of 59,700. We have seen already that the city is a great shopping centre. Industry too has an increasingly prominent place. The porcelain works are at the southern end of Worcester, beyond the Cathedral. Nearer to the centre are some of the long-established glove factories, for gloving is still an important trade, though less so than once it was. Worcestershire sauce lives up to its name and is still made in the city. But the largest industry now is engineering—most of it light engineering—with Heenan and Froude's near the main station as one of the best-known firms, and others of considerable importance. The picture is one of bustle and variety so that Worcester, for all its dignity and charm, is not one of the "sleepier" among our cathedral cities.

Last of all there are the Worcester personalities. Our first is not an individual but an institution. It is a notable thing for any town to have the oldest surviving English newspaper, and Worcester has this in *Berrow's Worcester Journal.* The paper started as the local news-sheet (but with very little local news) in 1690. It appeared at irregular intervals till 1709, but from that year the *Worcester Post-Man* came out every week, and *Berrow's*, after various changes of title and transfers of ownership, is its direct descendant; it kept its 250th anniversary in 1940 and even amid the worst days of the war the event was treated as a great occasion in English journalism.

Some important people are also of the 18th century. We have Thomas White, a notable figure among provincial sculptor-architects, and Dr John Wall is not only famous as a medical man and as the originator of Worcester porcelain, but was also a patron of letters and no mean amateur artist. A more unusual figure born in Worcester was Hannah Snell, the woman who served for many years as a Marine without her sex being discovered.

I suppose that Worcester's chief literary figure is Mrs Henry Wood, *née* Ellen Price, who was born in the city in 1814. She long lived abroad, but her later years were spent back in Worcester, and she became an important figure in the letters of her time. In her work she neatly combined melodrama and moral improvement, and achieved her greatest fame as the authoress of *East Lynne*; Worcester is the "Helstonleigh" of such novels as *The Channings.* But a far greater fame has come to Worcester from her great modern musician, and here we are back to the theme of the Three Choirs. For Sir Edward Elgar was born just outside Worcester, he lived in the city for many of his later years, he died there, and contributed greatly to the city's musical life. He was a Roman Catholic, and long served as organist of Worcester's Roman Catholic church, but he is commemorated also in the Cathedral by a simple tablet and a beautiful window whose theme is that of "The Dream of Gerontius", the oratorio which first brought him fame.

Making a New Atlas

by D. P. BICKMORE

Most readers of this Magazine know the value of a good atlas; few know what experience, breadth of vision and precise care for detail it takes to make a new one. The work involved in making the Oxford Atlas, *published this month, is here outlined by one of the men chiefly responsible*

"Why make a *new* atlas?" the man in the train might have asked: "Surely there are excellent old ones that only need bringing up to date?"

Of course, in a sense that is quite true; and it is probably the chief reason why the gigantic task of building up every map in a new atlas stage by stage from blank paper—a five-year job, it has been—is only undertaken about twice in a century.

But the time comes when mere revision is not enough, when world-relationships have changed so much that they need to be presented afresh. The end of World War II was such a time. Many areas of importance today were relatively unimportant before the war. The affairs of the world, for example, are no longer directed mainly from Europe. These changes in relative importance—political and strategic, social and economic—that have reached a climax in recent years add up to a new world.

"All the world's a stage"; and when we read or listen to the news we need two things: a general view of the stage into which the events we are reading about can be fitted; and a detailed view with the spot-light on the particular corner of the stage in which they are taking place—say Korea or the Persian Gulf. On the general view, we need to see how near, or large, or cold, or thickly populated some immediately interesting area is by comparison with other areas. This means that our 'new' world must be presented *as a whole*: in such a way that the comparisons leap to the eye. Again, in relation to such matters as the choice of scales, projections, colours, conventional symbols, lettering and transliteration of names there is need to coordinate all the maps in the atlas afresh and from a world standpoint, so that everywhere, as far as possible, like things may appear like and unlike things unlike. This recurrent problem of consistency, never completely solved, is common to all atlases; but we found that making a completely fresh start was a great help in our attempts to solve it, of which some examples will be found in what follows.

On the detailed view, the spot-light must reveal the latest information about each place onto which we turn it; and no map can ever, in detail, be up to date. Most of the world may have been 'explored', but there are still some enormous blanks that are slowly being filled in: Antarctica, for example, which is much larger than Australia, and Southern Arabia; while three-quarters of the world—even large areas of the United States—has never yet been properly surveyed, and surveys are constantly in progress, at a rate greatly increased by the use of air photography. Apart from all this, changes are continuous: new towns spring up, old ones get bigger; new railways and roads are built to link them—one has only to think of East Africa or Western Canada or the Pan-American Highway running like a vein down the leg of North America.

Finally, there is a technical reason for producing a new atlas now, and that is the improved processes of map reproduction, many of them due to the necessities of war: never did a war demand so many maps of unmapped places as did World War II.

"Well," the man in the train might have said, "there does seem to be a good case for a new atlas. But for whom is this Atlas intended?"

Being produced by a University Press, the new *Oxford Atlas* is first and foremost intended for students of Geography. You think immediately of schools and universities, and so indeed did we at the Press, for we were determined to produce an atlas which students could afford and which would try and satisfy some of their many requirements. But we also had in mind lots of people who certainly would not think of themselves as students of Geography, yet who are, so to say, "mapperate" in the sense that they reckon an Atlas, along with a Bible and a Dictionary, to be an essential article of household furniture. Besides these, the new Atlas will appeal to many other people who are by no means "immapperate": you, for example, who have bought a copy of this Magazine. You will find the same kind of pleasure in browsing through an atlas as you get from perusing

All photographs from the Oxford University Press

(Above) *Sir Clinton Lewis plotting the lines of latitude and longitude constituting the projection he has selected for each map.* (Below) *The positions of all features are traced from different maps, by fitting the appropriate latitude and longitude 'squares' over each other, onto a 'compilation'—*

—which is transferred identically in light blue to six white enamel plates. These serve as guides for the final drawings (in black ink) for each printing colour. (Above) *An artist paints between different contours to produce some of the layers.* (Below) *A draughtsman letters the names of towns*

back numbers of the Magazine. Both are fascinating occupations, and both improve if they are combined.

The story of our five years' work really starts during the war. Sir Clinton Lewis, the Editor, had been Surveyor General of India, and retired in 1940. For a large part of the war he ran an Ordnance Survey map factory. Colonel Campbell had been a friend and colleague of the Surveyor General's, and he, too, was running another map factory during the war. The organization responsible for seeing that the right maps were in the hands of the right troops at the right time was a part of the War Office known as the Geographical Section of the General Staff. In that organization, Kenneth Cook—a map printer in civilian life—was looking after research and experiments in map printing, while I looked after the compilation of many of the maps. But the Survey of India connection was the important one: not only do they produce beautiful and accurate maps (mostly at one inch to the mile scale over an area almost the size of Europe), but most of their officers, right up to the Surveyor General, are able themselves to superintend or even carry out any stage of mapping, from initial survey to actual printing. The significance of this was that five years ago we had good intentions—but no maps. We had to have editors who really were cartographers.

Nor did we know, until we had experimented, what our maps were going to look like. Did we want green and brown layers to show relief? Or should we adopt some more original colour-scheme? We toyed with the idea of shades of yellow and grey. Was "layering" the best technique anyhow, or should we try to use hachuring or hill-shading? I think the atlases which most influenced our choice of style were the old *Times Atlas* and some modern Swiss atlases. The latter were not entirely by coincidence, for Sir Clinton spent most of his youth in Switzerland and is a strong upholder of Swiss cartography, which has a tradition of pre-eminence dating back to the 15th century. Gradually we came nearer agreement about the kind of atlas that we would like to see and, eventually, the first colour-proofs of the first experimental sheet were made. They were ghastly! An ounce of practice is worth a pound of specifications.

But a decision on the style of our maps was only a beginning. If an atlas is to have 100 pages of maps (and the *Oxford Atlas* has 112), how many pages should be devoted to the British Isles or to North America; how many of them should be layered reference maps, and how many should be devoted to presenting such information as density of population, or land use?

Then projections: think of these simply as more or less ingenious means of presenting curved parts of the earth on flat pieces of paper. This impossibility can only be attempted with some distortion of shape, or area, or linear scale. On large scales in the Atlas sense (1/1 M, etc.) the distortion is not noticeable, but it becomes so at scales of about 1/16M and smaller. Now the shape of each area to be mapped, and, moreover, the shape of the important part of each area, is different from every other; so one of the aims that Sir Clinton steadily pursued was to provide a 'tailor-made' projection for each map, in order to ensure that the minimum in the way of scale errors, etc., would be introduced on each page and that such 'errors' should be in the least important part of each map.

The six drawings are checked: black for names, etc., red for roads and boundaries, dark blue for rivers, and the three contour-layer plates

When all last-minute information has been incorporated, each of the six drawings is photographed. The camera picks up only what has been drawn in black; the light blue of the compilation is lost

An example of these unusual projections is that which has been used for a map of North and South America together. This projection is an oblique Mercator; its axis (which is marked on the map) runs down a great circle from Alaska to Uruguay. No part of either continent lies more than 2000 miles from it, and thus scale errors are comparatively small, even at these extremities.

Another example is the projection used for the World Distribution maps showing population, vegetation, etc. The problem here was to achieve the largest possible scale for each of the continents while preserving as much equality as possible between equal areas. The projections used in previous atlases had given scales of between 1/90M and 1/100M: by ingenious juggling we have achieved 1/48M. Thus we can present all the continents together on the same page at a reasonably large scale without having to provide separate maps for each of them. By doing this, comparisons in distribution between different continents force themselves on the eye.

Much the biggest problem in producing an atlas map is to locate and name the towns. Seeing that this atlas was to be used principally by English-speaking peoples, the Editor decided to give preference to the English versions of place-names. Thus he offers Vienna and not Wien, though the latter does appear in brackets after the English version and both forms are given in the Gazetteer. Of course, no one bothers to invent English versions for the names of the vast majority of foreign towns—places like Abadan or Pusan; but many of these have to be transliterated into Latin script from, say, Russian or Japanese, and there are sometimes several ways of transliterating each name.

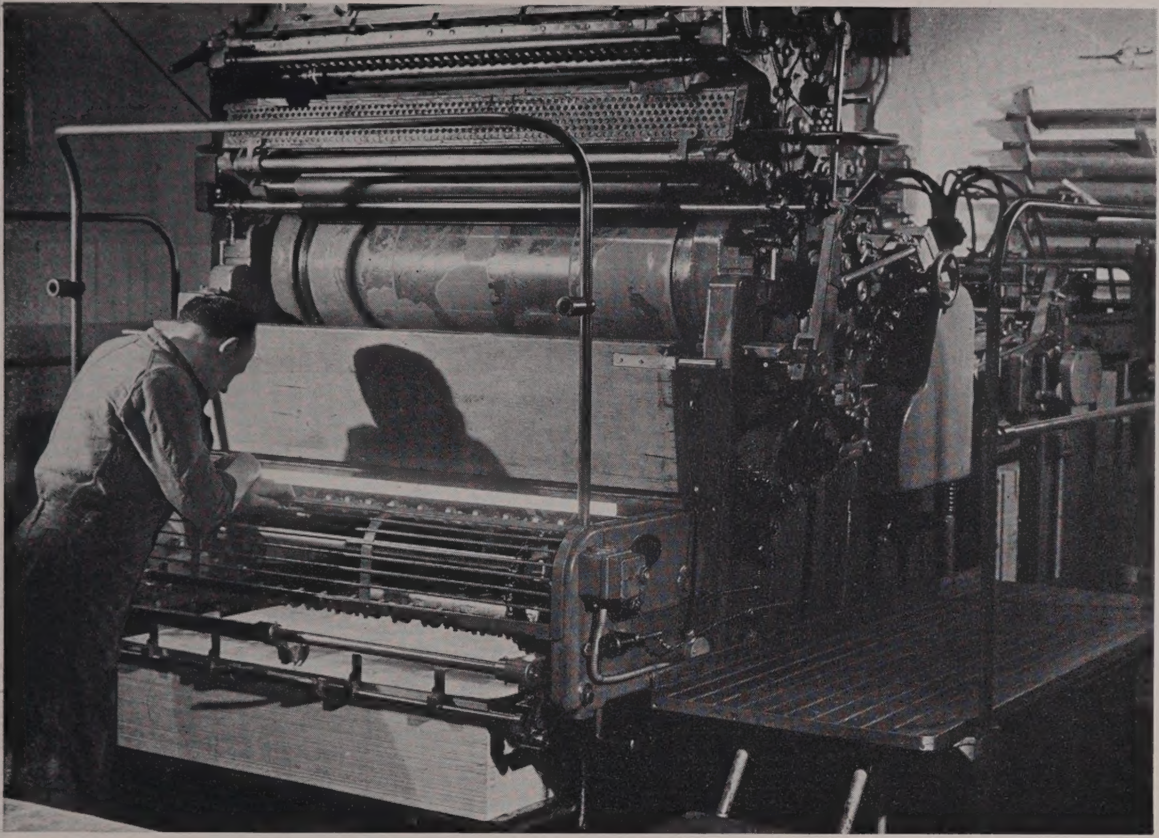
Another problem is the grading of town names and town sites. Grading must obviously be based mainly on the population of the town. But as Sir Clinton has written in the preface: "Grading worked out wholly on the basis of comparative population has disadvantages. For example, in the map of the Middle East, towns of comparatively small

Each printing plate carries everything that will appear in, say, red on eight atlas-pages. Thus the glass camera-plates have to be positioned with great exactitude over the zinc printing plate

population in Turkey have a significance as great as many places of far larger population in the Nile Delta. Thus a regional and not a world-wide basis for classification has been adopted, and extra emphasis is given where the town is an administrative capital or has some other special importance."

Although the final maps do not show actual contours, the edge of each layer tint is, of course, the line of the contour. Colonel Campbell was in charge of contours—an admirable arrangement, since he has surveyed many hundreds of miles of them on the ground in different parts of the world, from the Himalayas to the Grampians. Many of the foreign maps from which the Atlas was compiled show heights and contours in metres, and, since 3000 metres really is not the same thing as 10,000 feet, he had to pin-point a good selection of spot heights and then work his contours around and between them. But whatever the method, contouring the whole world is quite a job!

One by one the completed compilations were approved and went to the various draughtsmen who were to draw them: to Stanley Knight, for example, who had worked with me as a draughtsman during the war. He was now working in an Advertising Agency in Manchester, but was prepared to try and help our Atlas, and at the same time raise some money towards buying a house. That meant working at home, evening after evening from six to nine—relaxation, he called it: and, I suppose, lettering names of mountains across the map of Switzerland or filling in the coastline of the Mediterranean might well add glamour to a wet evening in Manchester. Every place-name on every map in the Atlas has been written by hand—in the tradition of British cartographers. Each name had to be written throughout the Atlas in a certain style, size and weight—to imply that it is a town of a certain grade, or a mountain range, or the name of a province. In one heavily settled part of Mexico all the names just happened to be very long ones (e.g., Popacatepetl or Cuernavacá) and each had to be twisted this way and that, so as to leave room for the next, and yet be un-



Each printing plate is fixed round a cylinder and the paper is fed through. The printing plate and the colour of the ink are then changed and the paper fed through again: six times altogether

ambiguously tied to the little black dot that showed its position. The draughtsmen found Sir Clinton a hard master in these matters!

We have attempted to make the Gazetteer a supplement to the maps by including in it such things as the names of sites of historical interest (e.g., Troy), and the populations of towns of 100,000 or over. For some parts of the world statistics about population are extremely difficult to discover—e.g., China; even for Britain the last available census figures were those of 1931. We have also attempted to indicate pronunciations of large towns. The system on which we based our pronunciation guide is that used by the B.B.C., who have to be prepared to instruct announcers in the pronunciation of the most obscure places at a moment's notice. We did not apply the pronunciation guide to English-speaking parts of the world, nor to France, where I was discouraged by the prospect of offering "PARIS (Paree)" in an Oxford book of reference. We are aware (and so indeed are the B.B.C.) that our system may have phonetic imperfections. But our purpose was limited to offering some assistance over names such as Szczebrzeszyn, which may leave some map-readers in the same tongue-tied silence as they leave some map-makers.

One by one the procession of maps reaches the reproduction stage. The separate drawings for one map, this one with names, that one with rivers, the next with roads, have been checked and cross-checked; we have finally decided to shut our eyes and close our ears to new information and, for better or for worse, hand them over to be photographed and printed. Map printing, as Kenneth Cook has modestly remarked on a number of occasions, is simply ordinary litho printing done just a bit better—Savile Row tailoring, as it were. Refinements are obviously necessary to achieve that degree of accuracy which, on a large sheet of paper, will invariably succeed in placing a small black dot on the correct side of a thin blue line. There was indeed a nasty occasion on one of the first proofs of the map of Southern England when half the holiday-resorts of the South coast got pushed a quarter of a mile out to sea; they were rescued all right.

This problem of fit or register is the essential one in cartographic printing. To get a good fit on a large printing plate each of the six colours has to be drawn separately on exactly the same material so that it will not alter in size; then each drawing has to be photographed with exactly the same focus and exposure, so that by the time the printing plate is made, the black town dot, the red road, and the blue river are all in exactly the correct relationship to each other. But even in 'mechanical' reproduction there are hazards: in the camera studio, for example, where power cuts, without warning, affect the arc lamps that illuminate the drawings while they are photographed, and throw out the most carefully calculated exposures. There are many 'human elements' in operating the enormous shining machines which print the maps sixteen pages on a sheet of paper and three or four thousand copies in an hour: to take a simple example, should any one piece of paper go through the machine for any one colour the wrong way round, someone is going to find sea where there should be land, or some other geographical freak. Every page has to be watched each time it emerges from the printing machine, through which it goes six times. The machine-minder has to mind his machine with the activity of an organist. There have been other crises; such as when it was discovered that some mis-spelt name had slipped past the eyes of many checkers to arrive glorying in its inaccuracy on the printing plate. A correction of this sort *can* be made, but the correct name had to be scratched on the printing plate by Mr. Hannan, the machine-minder, with the aid of a needle!

Even in the final stage—binding—the same degree of meticulous accuracy has to be observed. Nearly all our maps run right across double pages, whereas the normal book has a 'gutter' of an inch or so between the two blocks of type on facing pages. On a double-page map railways, coastlines, etc., run across the gutter, and inaccuracy in folding or stitching will produce an awkward side-shift down the map—a kind of fault running arbitrarily through a continent or country.

But finally, the piles of bound copies of the new Atlas begin to grow: this one for the American edition, that one for the Canadian edition, and the next for the British edition. It is just 250 years since the Vice-Chancellor of Oxford University gave his Imprimatur to "A New Sett of Maps, designed for the use of young Students in the Universities", by Edward Wells, M.A.—the first and only previous occasion on which an atlas has been made by a University Press. I wonder what Edward Wells would have thought if he could return to his native Oxford and see what we have done this time.